Morton's Hand Books of the Farm.

No. VII.

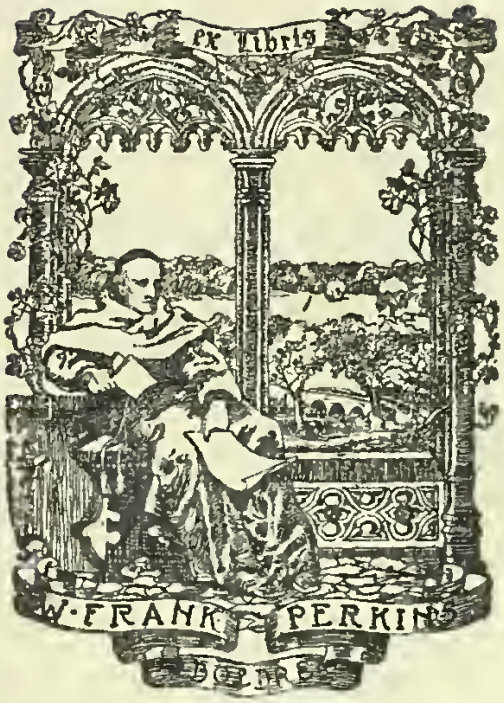
THE DAIRY

BY

JAMES LONG and J. C. MORTON.

VINTON & CO., Ltd., 9, New Bridge Street,

LONDON.



MORTON'S

HANDBOOK OF THE FARM SERIES.

Prepared under the direction of the late

J. CHALMERS MORTON,

EDITOR OF THE "AGRICULTURAL CYCLOPÆDIA;" THE "AGRICULTURAL GAZETTE;"
THE "FARMER'S CALENDAR;" THE "FARMER'S ALMANAC;"
"HANDBOOK OF THE DAIRY;" "FARM LABOURER," ETC.

MORTON'S HANDBOOKS OF THE FARM.

Edited by JAMES SINCLAIR, *Editor of Agricultural Gazette, Live Stock Journal, etc.*

No. VII.

THE DAIRY.

BY

JAMES LONG AND J. C. MORTON.

THIRD EDITION.

Revised and brought up to date.

LONDON:

VINTON & CO., LTD., 9, NEW BRIDGE STREET, E.C.

1892.

The present Volume is one of a series discussing the Cultivation of the Farm, its Live Stock, and its Cultivated Plants, the Farm and the Estate Equipment, the Chemistry of Agriculture, and the Processes of Animal and Vegetable Life. Among the writers who have been engaged on them are Messrs. T. Bowick, the late W. Burness, G. Murray, the late W. T. Carrington, the Rev. G. Gilbert, Messrs. J. Hill, R. Henry Rew, James Long, Sanders Spencer, and the late J. C. Morton, Professors G. T. Brown, J. Buckman, J. Wortley-Axe, and J. Scott, Dr. M. T. Masters, F.R.S., and Mr. R. Warington, F.C.S.

PREFACE TO FIRST EDITION.

THERE is no branch of English Agriculture which has more profited by the spirit of investigation and the practice of recording observations which have of late more or less possessed us all. To Mr. H. M. Jenkins, of the Royal Agricultural Society, we are indebted for a knowledge of French and Danish Dairying, which has done a great deal during the past ten years to improve our own dairy practice. And to the rivalry and records of breeds and of individual animals on the other side of the Atlantic we owe a knowledge of the possibilities of milk and butter produce of which no idea formerly existed. It is not too much to say that the traveller and the enthusiast, the inventor and the chemist, have together of late years lifted what used to be the homeliest and most stagnant of all departments of our Agriculture into the very foremost rank of all, so far as energy, activity, and all the other evidences of life are concerned. In the following pages, accordingly, along with the substance of a former handbook* published many years

* "Handbook of Dairy Husbandry," by J. Chalmers Morton. Longmans. 1860.

ago for the present writer, there will be found not only those pages brought down to the present date and re-written and condensed, but much added information on Foreign Dairying, contributed by Mr. James Long, and a tolerably full account of the improved practice and experience in our own Dairy districts at home.

1886. J. C. M.

PREFACE TO THIRD EDITION.

Since the appearance of the last Edition of this work, a good friend of British Agriculture, Mr. J. C. Morton, who was responsible for the bulk of the letterpress, has gone to his rest. A new Edition has been called for, and the great advances and changes—for there have been both—which have taken place in connection with the Dairy Industry, necessitated a corresponding revision of these pages, many of which have been re-written. The book has simply been brought up to date, without disturbing the design of its original author.

October, 1892. J. L.

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THE DAIRY OF THE FARM.

INTRODUCTION.

A BOOK on Dairy Husbandry ought to describe the management of the farm so far as that is directed to the production of milk, as well as the processes of the dairy through the medium of which milk is made to yield its various marketable products.

The present Handbook is, however, one of a series; and some of the topics usually included in an extended review of dairy farming have been discussed elsewhere. The particular management, both of breeding stock and of the crops cultivated for their food, has already been described. In the Handbook of the Live-stock of the Farm, also, there are chapters on dairy and other breeds of cattle, and short instructions are given not only on the duties of the herdsman, but on those of the dairyman also; and the reader will find, in a condensed form, some of the information which is more fully given here. Although, therefore, it is intended in the present Handbook to give shortly the answers of experience to such questions as—What crops should be grown? what cattle should be kept? how should they be managed, in order that the largest

quantity and best quality of milk may be produced?—yet our chief purpose is to supply in full the information which the dairyman rather than the farmer needs, and in chapters on dairy statistics, on the food and choice and treatment of the cow, on milk, butter, cheese, and general management, and on foreign dairying, to describe the experiences of the dairy farmer, and the manufacture of butter and cheese, as carried on in foreign countries and in our best dairy districts.

CHAPTER I.

DAIRY STATISTICS.

Dairy Produce—Milk—Butter—Cheese—Stock and Produce per Acre—Stock and Produce of the Country.

THE butter made from a given quantity of milk, the produce of ordinary herds of cattle, is rarely more than 4 per cent., varying from one-thirtieth to one-twentieth of its weight. The cheese made from a given quantity of milk is generally about one-tenth part of its weight. The quantity of butter and of cheese which milk will yield depends upon the breed of the cow and its individual character; upon the number of weeks or months during which it has been in milk; and upon the food which it receives. All these particulars are included in the general management of the dairy farm. But it also depends upon the system of management adopted in the dairy and upon temperature and skill in manipulating the milk, cream, and curd. Add to the influence of all these circumstances affecting the quality of dairy produce, the fact that the quantity of milk which a given acreage of land will yield varies enormously with its quality and the way in which it is cropped and stocked, and it will be easily understood how the widest diversity of experience and opinion in dairy management comes to prevail.

It may be observed here, although the chemistry of the subject has been elsewhere discussed, that the quantity of butter and of cheese respectively which milk yields to the dairyman, differs materially from the quantity which it yields on examination by the chemist. The casein, or strictly cheesy part of milk, does not generally exceed 4 per cent. of its weight; but the full milk cheese of the dairy contains much besides the mere casein of the laboratory; generally speaking, less than one-third is casein; about one-third is butter; often more than one-third, when purchased by the factor, is water, and $3\frac{1}{2}$ to $4\frac{1}{2}$ per cent. of its weight is salt and other mineral matter. A small percentage of sugar is also present. It may well be then that milk containing 4 per cent. of casein should yield 10 per cent of marketable cheese, or even more if the butter percentage is high. And so with the butter of the market; it differs considerably from the butter of the laboratory, containing, in addition to the pure fatty matters of which alone the chemist takes account, half to one per cent. of casein, and 12 to 15 per cent. of water, besides a minute quantity of mineral matter and sugar. And if these additions do not increase the butter made in the dairy beyond that which is extracted in the laboratory, it is because so much is lost by the imperfect means of manipulating the milk which are adopted.

The object of the dairy farmer being to derive the largest possible profit from his land, he crops the arable portion, and manages the grass in order to keep a full stock of dairy cows; these he selects of the best class and from the best breeds for the produce of milk for sale, butter or cheese, according to his purpose. Having

thus insured the largest produce of the quality of milk desired, he regulates his dairy management in order to obtain from it, as cheaply as possible, unless he is solely a milk seller, as much of the finest cheese or butter as it will yield. Successful dairy farming thus implies a knowledge of the crops, the stock, and the dairy management best adapted to a profitable yield of milk, butter, or cheese. And these are the three divisions under which it is proposed to arrange the details of dairy experience in the following pages, this preliminary section being devoted to a statement of its gross results in a variety of instances.

The Yield of Milk.—At the Conference of the British Dairy Farmers' Association, in Yorkshire, in 1890, Mr. Christopher Middleton quoted from the milk register kept on the Eston Grange Farm of Messrs. Bolckow, Vaughan and Co., which the members of the Conference subsequently inspected. He showed that 20 of the 40 cows gave the extraordinary average of 1,005 gallons per head, one animal reaching 1,430 gallons; the ration while upon grass including 3 lbs. of cotton cake and 1 lb. of maize and pea-meal. Mr. Middleton himself owns a herd of Guernseys, several of the cows in which have exceeded 800, and some 900 gallons; while many of the heifers have given between 600 and 700 gallons after their first calf. The herd of cows (Shorthorns and Ayrshire crosses) at the Munster Dairy School yielded 721 gallons per head during the first 9½ months of 1886, the winter ration being 28 lbs. mangels, 20 lbs. hay, and 9 lbs. of meal. Mr. Richard Barter's (Cork)

herd of Shorthorns, Dutch and Ayrshire crosses, with one Kerry, averaged 731 gallons in 1887, the summer feed being supplemented by 2 lbs. of undecorticated cotton cake and 1 lb. of malt coombs, and the winter ration consisting of 7 lbs. hay, 42 lbs. gorse, 42 lbs. mangels, 7 lbs. grains, 6 lbs. oats and barley, and 2 lbs. bran. Lord Braybrooke's herd of 20 Jerseys was stated in the *Agricultural Gazette* in 1885 to have yielded an average of 478 gallons each. The Jersey Cattle Society show that, upon the basis of 133 tests, cows between three and four years old gave 29 lbs. 4 ozs. per day; between five and seven years, 31 lbs.; and between seven and nine years, 30 lbs. 7 ozs. The average yield of dairy Shorthorn cows owned by the Duke of Westminster, at the Grange Farm in 1890, was 714 gallons. A cow, Lyddy, owned by Sir John Lawes, Bart., gave 72 lbs. 7 ozs. of milk in one day. An Ayrshire owned by Mr. Wallace, of Kirklandholm, gave 13,456 lbs. of milk in 365 days. In America many instances have been recorded of Dutch cows giving over 1,500 gallons of milk in a year, and we have personally met with cows in Holland which have given 40 quarts in a day. Examples of cows of the dairy Shorthorn and Ayrshire varieties yielding over a thousand gallons in a year may be found in numerous herds.

The Islington milking trials which the Association has conducted afford valuable information, in spite of the fact that it has been obtained from selected cows of presumably high milking capacity. We give the average day's yield of milk of the nine years' trials, the percentage of butter and total solids, and the average weight of three of the leading breeds:—

	Milk. lbs.*	Total Solids, per cent.	Butter Fat, per cent.	Weight, lbs.
Shorthorns ...	42·55	12·87	3·71	(9) 1,359
Jersey ...	27·58	14·04	4·04	(19) 840
Guernsey ...	27·17	14·09	4·65	(5) 1,626

* About 10¼ lbs. = 1 gallon.

From these instances it may be safely gathered that the average yield of well-managed cows varies from 450 to 600 gallons of milk a year, according to breed and size; the smaller breeds, such as the improved Kerry, yielding but little less than the former of these quantities; and the larger, as the dairy Shorthorn, and some good cross-breeds, yielding even more than the latter.

It will also be understood that, by skilful feeding and first-rate management, the average yield of a small dairy breed like the Ayrshire may be raised as high as 600 or 650 gallons annually; and that, by corresponding treatment of the larger breeds, their yield may be raised as high as 800 gallons and upwards, as in some of the instances quoted. The experience of skilled dairymen proves, indeed, that these figures may be exceeded; and where cows are kept solely for the provision of milk, and replaced by others at a loss of 6*l.* or 7*l.* a-piece so soon as their yield falls below about six quarts a day, the annual yield of the large-framed Shorthorn cow may, by good feeding, be kept at nearly 1,000 gallons annually on the average number of the herd in stall throughout the year.

The Yield of Butter.—The percentage of butter extracted from milk has materially increased since the introduction of the separator. It is probable that where

30 lbs. of milk was formerly required to produce a pound of butter, 27 lbs. only is required where this machine is now used. There is no reason why this quantity should be exceeded in any dairy which is supplied with milk from well-managed cattle. As the separator is so entirely superior to all the old methods of creaming, and as it must supplant them all, it is useless to estimate the yield of butter upon any other basis. Those who can afford to ignore a system which will increase the returns of the dairy so largely, are not likely to read this or any other work on the subject with an economical view. Colonel Curtis Hayward, of Quedgeley, near Gloucester, whose cattle are chiefly Shorthorns, and whose accounts are very accurately kept, found that in the year ending March 31, 1891, it took on the average 23·64 lbs. of milk to make one pound of butter, or 24·74 lbs. from April to September, and 22·55 lbs. from October to March. It should be observed, however, that about one-half of the milk was purchased.

Mr. Penrose Fitzgerald states that the milk of some 300 cows, of which all but about 50 (Kerries) are Shorthorns, is separated in the Midleton Factory (co. Cork), the average quantity required to make a pound of butter being for the year 28·5 lbs., this figure falling to 25 lbs. in November, whereas, he adds, if there were no winter calves it would require no more than 23 lbs. in December. At the Dunragit Creamery, where considerable skill is exercised in the work, the quantity ranges between 22 lbs. and 33 lbs., the milk being produced chiefly by Ayrshire cows. The manager of the Farnley Butter Factory finds that it requires 28 lbs. of purchased milk to produce 1 lb. of butter the year

through. At the Cathedral Dairy, Exeter, the quantity varies between 22½ lbs. in autumn to 27 lbs. in spring. In 1886 Mr. James Long tested the milk of eight selected Bucks dairy Shorthorns. The milk separated in the two days of the test was 669 lbs., and the butter churned 36 lbs., or 1 lb. per 18·5 lbs. of milk. The tests conducted under the auspices of the Jersey Cattle Society have elicited valuable information. So far the highest yield of butter recorded in one day is 3 lbs. 5 ozs. by Mr. Brutton's Baron's Progress at six years old. As she gave 37 lbs. 5 ozs. of milk, the ratio of butter to milk was as 1 is to 11·3 lbs.; the separator was used. At the Winchester trials in 1890, Mr. Callender's Young Dorcas gave 3 lbs. 2¼ ozs. from 28 lbs. 4 ozs. of milk, or 1 to 8·99, an astounding ratio. The average ratio of milk to butter of the 133 cows tested is for heifers, 20·1 lbs.; for cows between 4 and 5 years, 19·41 lbs.; between 6 and 7 years, 17·81 lbs., and between 8 and 9 years, 18·64 lbs. Although some doubt has been cast upon the accuracy of American tests, there is no question that surprising results have been achieved by both Dutch and Jersey cattle in the States. Cows, descendants of the late Mr. Dauncey's bull Rioter, are reported to have yielded 867 lbs. to 778 lbs. and 900 lbs. of butter within the year. Thirty cows bred similarly to one of these animals are said to have averaged 20 lbs. of butter per week; and twenty-seven cows, daughters of another bull of the same family, averaged over 20 lbs. of butter per week. Jersey cows of other families are recorded as having yielded 936 lbs. and 945 lbs. of butter in the year, while a Dutch cow, Parthenia, one of many wonderful butter makers, is credited with the yield of 548 lbs. of milk,

and 35 lbs. 8½ ozs. of butter in seven days, upon a ration of 27 lbs. of ground oats, maize, linseed, and bran, while running upon pasture.

Yield of Cheese.—The yield of cheese in proportion to milk is shown in the following instances of experiments made by the writer :—Cheddar System, 120 lbs., milk partly Jersey ; curd when vatted, 13½ lbs. ; cheese when ripe, 11 lbs. 13 oz. 305 lbs. new milk, partly Jersey, produced 35 lbs. curd and 28¾ lbs. ripe cheese. 80 lbs. new milk and 80 lbs. skim produced 20 lbs. curd and 13¼ lbs. ripe cheese. At the Dairy Institute, Aylesbury, the following weights were obtained from ordinary farm Shorthorn milk :—

	lbs. milk.	lbs. curd.	lbs. ripe cheese.
April 26	240	26	22
May 15	300	33	28
June 21	280	33	27¾
July 8	240	28	22
Aug. 10	220	25½	22½
Sept. 2	200	24½	21

The following figures show the actual weights of Stilton :—120 lbs. June milk, about one-quarter Jersey, produced 20 lbs. curd and 11 lbs. blue cheese ; 288 lbs. of similar milk in August produced 52 lbs. of curd and 27¾ lbs. ripe cheese. Mr. David Byrd, of Tarporley, a justly famous Cheshire cheese-maker, sold 24 tons and 9 lbs of cheese, or 4 cwt. 23½ lbs. per cow, on the average of 114 cows, in 1884, besides 1,372 lbs. of butter, whey valued at £1 per cow, and 6,843¼ gallons of milk. This would probably represent over 600 gallons per cow, when we include the milk necessarily given to the calves, 64 of which were sold and 40 reared. Cheshire

dairy farmers sometimes reach $4\frac{1}{2}$ cwt. (of 121 lbs.) per cow, and we have heard of 5 cwt., but this extra yield is generally obtained at the expense of the sale of milk. In Ayrshire it is a custom for the "bower" or dairyman renting the dairy to pay the farmer 480 lbs. of cheese for each cow, and 384 lbs. for each heifer, the cattle in each case being Ayrshires. Such is the plan adopted upon the smaller farm of the champion cheese-maker, Mr. Frederick, of Drumflower.

Stock and Produce per Acre.—On this point, four or five cases of actual experience may be quoted. In the case of the First Prize Dairy Farm, near Shrewsbury, in 1884, a herd of 50 cows on 185 acres, two-thirds pasture, produced close on 5 cwts. of cheese per head, besides some 30 cwts. of butter in the year. Here the cows were very good dairy Shorthorns, fed liberally throughout the year. Mr. Byrd, already named, kept his 114 cows upon 354 acres, of which only 38 are under the plough. In Scotland, Mr. Frederick keeps 90 cows, besides calves and a large number of pigs, on 300 acres of arable land. Mr. Whyte, of Kirkmabrech, keeps 112 cows, besides heifers and calves, on 400 acres of arable, which also carries a few hundred sheep and some high-bred Clydesdale horses. Many instances of a similar kind could be adduced, as well as others showing a still larger head of stock per acre. The stock-carrying capacity of a dairy farm, however, depends largely upon the quantity of cake or corn purchased. Undoubtedly a well-managed arable farm is the most economical, especially where heavy forage and root crops can be grown, the yield largely depending upon

the enrichment of the manure by the liberal use of nitrogenous foods. We may, however, quote the case of Mr. E. Hothersall, of Lightfoot Farm, near Preston, who won the first prize in his class for the best dairy farm when the Royal Agricultural Society's meeting was at Preston, in 1885. This gentleman kept 48 to 52 large Shorthorns upon 97 acres of grass, but his purchases of food—grains, cake, bran, meal, roots, etc.—amounted in value to £651, although this sum included food for several horses, some pigs and poultry.

Mr. Fearnall, of Royton, one of three brothers, all first-rate dairy farmers, keeps 100 cows, besides rearing 30 heifers annually and fattening 150 pigs and porkers, upon 342 acres, of which 55 acres are arable. In 1885, when Mr. Fearnall competed for the Royal Farm prize, his average return exceeded £22 per cow, and his consumption of cake and grain included purchased food costing £365, and home-grown food to the amount of 10 tons of barley, 20 tons of oats, and 10 tons of beans. Mr. Thos. Parton, who took the second prize for the best farm in the Royal competition, kept 67 cows, 16 two-year-olds, 27 calves, and 2 bulls upon 166 acres, of which 82 acres were arable; the sales of milk, cheese, butter, and pigs averaging £22 12s. 10d. per cow over 64 cows, in addition to which calves sold realised £97 10s. Here £132 was expended for manures and £530 for foods, or about £4 per acre. The Channel Islands afford numerous instances of the heavy stocking of land. Mr. P. Le Mesurier, of St. Peter's, keeps 45 cows and heifers, besides calves, a bull, and some pigs, upon 45 acres by the aid of heavy forage cropping. Lucerne and rye

grass enabled Mr. Ozanne to keep 2 bulls, 3 cows, and 22 heifers upon 12 acres.

The whole of these farms and herds, and many others of similar character, we have seen for ourselves, and we are therefore the better able to point out that the results shown are only attained by the exercise of the highest skill and the most energetic management.

These examples are, however, instances rather of high average than of possible produce. Good dairy farms will keep a cow for at most every three acres of pasture, and under good management, with some arable land in addition, a smaller extent will suffice. The object of a book on the subject should be rather to present the maxima of agricultural experience, and thus stimulate progress, than to dwell merely on averages, though a knowledge of these is necessary to a truthful statement of ordinary dairy statistics.

Stock and Produce of the Country.—In this paragraph we give such figures as the annual agricultural statistics of the country provide. It is significant of the growing extent of the share of the pastoral, grazing, and dairying interest in the agriculture of Great Britain, that the area in permanent pasture has increased nearly one-fourth during the past twenty-two years. It was 12,735,897 acres in extent in 1869; it was 16,433,850 acres in 1891. Three and a half millions of acres have been laid down with permanent grasses during this period. The number of cattle has also increased, and almost in the same proportion. There were 5,313,473 cattle of all ages in 1869, and there were 6,852,821 of all ages in 1891. Of these, 2,657,054

were cows and heifers in milk and in calf. The corresponding figures for the United Kingdom, including Ireland, were 22,811,284 acres of permanent pasture in 1869, and 27,567,663 acres in 1891; 9,078,282 cattle in 1869, and 11,343,686 in 1891, of which 4,117,707 were cows and heifers in milk and in calf. With all deductions for those breeds which do little more than rear their calf, and for those breeds where the whole milk is devoted to the raising of stock and the fatting of veal, and considering, on the one hand, the small yield of some breeds and, on the other, the large quantity produced by cows now fed especially for the yield of milk, we may assume that the 4,117,707 cows yield nearly 1,480,000,000 gallons annually. Of this at least one-fifteenth is taken for calves; and if the consumption of milk, which has very greatly increased of late years, be put at one-quarter of a pint a-piece daily for each one of the population, 430,000,000 gallons thus consumed must be deducted, leaving 950,000,000 gallons for the manufacture of cheese and butter, a quantity equal to the production of 303,000,000 lbs. of cheese and 214,000,000 lbs. of butter—a quantity which would provide about 7·9 lbs. of cheese and 5·6 lbs. of butter a-piece per head of the population per annum, allowing for the small quantity exported. That this is not enough, and that there is a growing deficiency in the home supply, is proved by the increasing quantity of butter and cheese which is annually imported as appears from the following table:—

Year.	Imports.		Year.	Imports.	
	Butter.	Cheese.		Butter.	Cheese.
	cwts.	cwts.		cwts.	cwts.
1871	1,334,783	1,216,400	1885	2,401,373	1,833,832
1876	1,659,492	1,531,204	1886	1,543,566	1,734,890
1880	2,326,305	1,775,997	1887	1,513,134	1,836,789
1881	2,047,341	1,840,090	1888	1,671,433	1,917,616
1882	2,169,717	1,694,623	1889	1,927,842	1,907,999
1883	2,334,473	1,799,704	1890	2,027,717	2,144,074
1884	2,475,436	1,927,139			

MARGARINE.

	cwts.
1886	887,974
1887	1,276,140
1888	1,139,743
1889	1,241,690
1890	1,079,856

Margarine was included with butter until 1886.

Taking the imports and exports as our basis, the consumption of imported butter and cheese per capita is as follows, the addition of the figures given above showing the total consumption per head of our population per annum:—

	Per head.	
	Butter.	Cheese.
Consumption of imported	9·4	5·7
Consumption of home-made	5·6	7·9
	15·0	13·6

CHAPTER II.

FOOD OF THE COW.

Pasturage—Summer and Winter Feeding—Relations of Food to Pasture—Malt and Barley—Crops of the Dairy Farm, Ensilage—Schemes of Cultivation for Dairy Farms.

It is intended in this chapter to describe actual practice in a number of instances of cow feeding; to state such facts as are known on the relations of various foods to the yield and quality of milk; and to enumerate the crops proper for cultivation on a dairy farm.

The Food of the Cow in the common practice of our dairy districts is pasturage in summer, and hay and chopped straw with, in most cases, turnips or mangel-wurzel in winter. She will consume in depasturing from 1 to 1½ cwt. of grass daily, varying of course according to age and size; or during seven months of grazing as much as 12 to 16 tons of green food. Pastures which would by July have growth enough on them to make from 20 to 40 cwts. of hay, and which will when that is cut grow probably three-fifths as much grass after July 1st as they had grown before, will, if their growth be eaten down from week to week throughout the season, have produced from 7 to 14 tons of green food per acre. From 1¼ acres of the best grass lands to as much as 2½ of the poorer class will thus be

wanted for the summer maintenance of the cow. One acre of whole grass and the aftermath of another acre which had been mown for winter hay will in the former case be sufficient for a cow; and double that extent will be needed in the latter case. The cow will thus receive fully ¼ cwt. of hay daily during the five winter months. In Gloucestershire 2½ tons of hay a head are considered an ample winter's allowance. In Cheshire 2½ to 3½ acres of grass land per cow are the general allowance in order to supply sufficient summer pasturage and winter provender; but the dairy farms in that county generally have a larger proportion of arable land attached to them, and it is common to give the cows turnips, mangels and straw, as well as hay. Cheshire dairy farmers are practical feeders, and add liberal allowances of cake, bran, and maize-meal to the ration when the cows are in full milk during winter. Cabbage and grains are also used upon some farms.

In the now famous dairy counties of Ayrshire and Wigtownshire the cows graze from May until October, getting straw, turnips, and swedes, 5 to 7 tons per head, from October until the following grazing season, together with bean meal, cake, and oats at the rate of about 4 lbs. a head. In some cases—a specific allowance being made to the "bower" who manages the cows—the allowance of meal is smaller, 280 lbs. a head for the actual winter feeding. On many Scotch farms the food is largely cooked—turnips, chaff, meal, and draff (grains), where used, being boiled together and given to the cows hot. There is a very general practice in many parts of England of mixing pulped roots (swedes in winter and mangels in spring) and chaff together, and heaping a

day before use, by which time it has heated. In some cases grains, which have been purchased in summer and pitted, are mixed with this "chop"; in others, bran, meal, or malt culms are used instead. These mixtures form the main ration, while oat straw is given between meals, and in some cases a little hay or even cake. The economy of feeding depends upon the utilisation of the food grown upon the farm, and both straw and roots can be given with admirable results in combination with a concentrated food such as cotton cake, bran, or bean meal, all of which are rich in the constituent, nitrogenous matter, in which the coarse foods are deficient. In Jersey and in the richer districts of Normandy the cows are tethered upon clover, vetches, lucerne, or *trifolium incarnatum*, with the best results, all these foods being rich in nitrogenous matter. In Switzerland grass and hay are almost the only foods used. In Holland, another excellent dairy country, the same foods are the staple; rape cake, however, is largely used in winter. In Sweden, hay is the chief winter food; while in Denmark, where arable land is more abundant, mixed rations, with meal or rape-cake, are much more general. It is now the practice to treat the cow much more liberally during the winter months and when she is dry than used to be the rule. The bare condition in which, after calving, the cow was often turned out to grass in spring is now quite understood to be bad farm management. The large number of cows which are now brought to the pail in autumn for the provision of milk in winter for the supply of towns, makes, of course, the distinction which used to obtain between winter and summer feeding no

longer applicable, and the yield of milk is often stimulated by the most liberal treatment, both as regards food and shelter. Great reliance is placed on grains by many farmers, a bushel a day per cow, or even more, being given, together with 12 to 18 lbs. of hay, and ½ cwt. of roots, chiefly mangel, or, in place of the two last, abundance of cut green food, clover, vetches, lucerne or rye grass during summer. A common method is to pasture the cows in summer, giving them cut green food in addition towards autumn and in early summer, and to feed in stalls or sheds on roots, grains, cake, and hay, and steamed messes during winter. The practice of giving warm mashes is more common in the north. For small Ayrshire cows, the following has been found a sufficient winter dietary on which to keep them in full milk:—30 to 40 lbs. of boiled turnips, with 6 lbs. of cut straw, 2 gallons of grains, and 3lbs. of bean-meal mashed up in them, oat straw *ad lib.* being supplied in addition. Mr. Horsfall's winter feeding was remarkably liberal, and he received his return for it in the fattening of his cows at the time they were giving milk. The following is the report of his management to the Royal Agricultural Society:—He had for four years given his dairy cows rape-cake, of the kind termed "green" cake, which imparted to the butter a finer flavour than cake of any other description; and in order to induce them to eat it, he blended it with one-quarter the quantity of malt-dust, one-quarter bran, and twice the quantity of a mixture in equal proportions of bean-straw, oat-straw, and oat-shells; all well mixed up together, moistened, and steamed for one hour. This steamed food had a very fragrant odour, and was much

relished by the cattle: it was given warm three times a day, at the rate of about 7 lbs. to each cow (or 21 lbs. daily). Bean-meal was also scattered dry over the steamed food, cows in full milk getting 2 lbs. per day, the others but little. When the animals had eaten up this mixture, they were each supplied daily with 28 lbs. to 35 lbs. of cabbages from October to December, of kohl-rabi till February, or of mangels till grass time; each cow having given to her, after each of the three feedings, 4 lbs. of meadow hay (or 12 lbs. daily). The roots were not cut, but given whole. The animals were twice a day allowed to drink as much water as they desired. Mr. Horsfall ultimately discontinued the use of bean-meal, owing to its comparative price, and in its place, along with about 5 lbs. of rape-cake, gave an additional allowance of malt coombs, and 2 or 3 lbs. of maize-meal per cow. On this food, in instances actually observed, his cows gave 14 quarts of milk a day, at the same time that they gained flesh at the rate of about one-quarter of a cwt. per month.

Although summer grazing is the commonest and simplest practice, yet everything depends upon the quality of the grass. On poor herbage, especially that deficient in clovers, it is usually found advantageous to give the cows a daily allowance of cotton cake, the flow of milk increasing, while the increased value of the manure has the best effect upon the pasture, which is gradually improved.

Relations of Food to Dairy Produce.—It is difficult to say of any agricultural result how much of it is due to any particular cause; and in the case of dairy pro-

duce, so many causes contribute to the result that the difficulty is greatly increased. The breed, the individual character of the cow, its treatment, and the dairy management of its milk—all, as well as the food which it receives, affect the quantity of butter or of cheese which is obtained from it; and thus comparative experiments made in order to ascertain the effect of particular foods must be carried on for a length of time before their results can be considered trustworthy.

Experiments which have been made by Sir John Lawes, at Rothamsted, have furnished dairy farmers with information of the most valuable nature. Sir John says that 1 ton of milk (about 220 galls.) can be produced per acre upon first-rate land, so that a cow giving nearly 800 gallons would require $3\frac{1}{2}$ acres. An acre of very good pasture will increase the weight of a store ox from 1,200 lbs. to 1,700 lbs., the increase containing from 300 lbs. to 350 lbs. of dry matter, of which 35 lbs. would be nitrogenous. Now the dry matter contained in 800 gallons of milk would amount to more than 1,000 lbs., including nine times as much nitrogenous matter as was contained in the increase in the ox. Thus the production of milk is shown to be much more exhausting than the production of meat by a grazing ox. Writing in 1887, Sir John Lawes said that during the winter months his purchased food consisted of decorticated cotton cake and bran, the bran being given only when the cows were taken in and stall-fed. A rule was adopted that when a cow gave 28 to 30 lbs. of milk daily during one week, she should receive 4 lbs. of cake per day during the next, and at the end of that week the cake should be increased or decreased one-quarter

of a pound daily for each 2 lbs. per day of increase or decrease. This rule was not strictly carried out, the quantity being sometimes found to be too large to be economical. In one instance the results pointed to the belief that the liberal use of cotton cake considerably retarded the falling-off in the yield. The following table relating to the results at Rothamsted are most interesting and instructive :—

Yrs.	No. of cows.	No. of weeks.	Galls. per head.	Cake consumed per gall. lbs. & ozs.	Bran consumed per gall. lbs. & ozs.
1884	40	47	876	—	—
1885	50	52	884	—	—
1886	46	49	810	1·7	0·12

In another table it was estimated at Rothamsted that 4 lbs. of cotton cake and $3\frac{1}{2}$ lbs. of bran would produce as much digestible nitrogenous and non-nitrogenous substances as would produce 30 lbs. of milk. The experiments of Lawes and Gilbert suggest that if suitable purchased foods are given soon after calving, the yield of milk can generally be increased, and that such milk would have a tendency to become richer rather than poorer.

The teaching of science has been of immense benefit to those who have availed themselves of it, but the maxims of ordinary experience should never be neglected.

Crops and Foods for Dairy Stock.—The cultivation of the crops suitable as food for dairy stock has been described in another Handbook. At present a mere list will be given of these crops, with a reference to their probable yield per acre, the period of year during which each is available, etc. (1.) *Pasturage.*

The grass of old meadows of good quality is the best possible summer food for dairy cows. They will usually consume from 1 cwt. upwards of green food daily. The annual yield of grass from meadows will vary from 7 tons per acre up to 14 tons, according to the season. It is available in this climate generally from early in May till the middle of November or later, during which time an ordinary cow will consume from 10 to 14 tons of green food. (2.) *Hay*, well made from good meadows, is the very best food for dairy cows. It is, however, greatly economised by the addition of straw and roots, meal, and cake, but when given alone must be supplied at the rate of 40 lbs. daily, or thereabouts, a head. (3.) *The Clovers* afford capital grazing for young stock, and on arable dairy farms to milch cows also. They may yield on good land, well cultivated, in two or even three cuttings, if the season be favourable, 10, 6, and 4 tons respectively per acre; or from 12 to 13 tons per acre during the season. If the cattle are foddered, as in small dairies they may be, these and other green foods must be supplied at the rate of fully one cwt. daily. They are available from June or July till October. (4.) *Vetches* sown in October, and again in April, May, and June, may be made to provide a succession of food all through the summer, commencing in May. They yield one cutting, which may furnish from 6 to 10 tons of green food per acre: a very succulent food if given before its flowers appear; and the better, therefore, for being cut 12 to 24 hours before use, in order to wither and prevent cattle being blown. Vetches may be given with excellent effect chopped with straw. (5.) *Rye*, cut green, is one of the earliest of spring foods; sown from July

to September, it is available in April and May, yielding perhaps four or five tons per acre of green food, and more as the crop approaches maturity, when of course it becomes less appropriate as a summer food. (6.) *Italian Rye-grass* is one of the best forage plants for cows when cultivated liberally. If manured abundantly after each cutting, especially if the dressing can be washed in by irrigation, another cutting, weighing sometimes 10 or even 15 tons per acre, will be ready in a few weeks. And as many as five heavy cuttings have been obtained from it in the season on sewage farms. When sufficiently ripened, it is one of the best possible cut foods that can be given to cows, inducing an abundant yield of excellent milk. (7.) *Lucerne*, on deep, rich, and sheltered soil will also yield a succession of cuttings of excellent food for cows, weighing on an average from 6 to 8 tons per acre at each cutting. (8.) *Sainfoin* may be classed with the clovers as to quality and quantity of produce, but it rarely produces two heavy cuts in a year. Like lucerne, it is available for several years on the same land, requiring of course to be manured if constantly cut; it is suitable for calcareous soils, where clovers are not generally so successful; and it yields probably 10 to 12 tons of green food, under good management, per acre. (9.) *Gorse*, crushed and given with other food, is liked by cows, and has been successfully used in dairies. It is available during November and the winter months, and, given at the rate of two bushels of the bruised material along with carrots and a little hay, is one of the most useful winter foods for cows in milk. (10.) *Rape* is useful in early winter; it is less liable to affect the flavour of milk than turnips, and is a very succulent and palatable food.

Capable of being mown and brought in daily from the field, it is available as a daily food during September, October, and November, and, indeed, formed a portion of Mr. Horsfall's feeding of his well-managed dairy herd. A crop of rape will yield from 10 to 12 tons of green food per acre. (11.) *Cabbages* of various sorts, open and hearted, early and late, are much relished by cows, and, when liberally manured, will yield a succession of food from May all through the summer, and on till the end of the year. Land yielding successive crops of cabbages will produce an enormous weight of food—even 40 or 50 tons per acre during the season. No more than half a cwt. a day, supplemented with more substantial food, preferably of a nitrogenous and binding nature, such as bean or pea meal, or decorticated cotton cake, should be given to a cow; and care should be taken to remove any spoiled portions of the ration, which, if consumed, would greatly aggravate the disagreeable flavour which, under the most careful management, they are apt to give to the milk. (12.) *Turnips*, common and Swedish, are given to cows, the former in early winter, the latter on till towards spring. They will yield from 10 to 20, and even 25 tons per acre, but they are a faulty food, owing to the flavour which, without special management, when used in large quantities, they give to the milk. Sixty to eighty lbs. daily, along with an unlimited supply of straw, is an ordinary daily ration on some farms. These roots are less liable to affect the milk if steamed, or even if merely pulped, but in any case the crown should be cut off low down; 15 or 20 tons of common turnips per acre, and 12 to 15 tons of Swedish turnips, are an

ordinary crop, but they are liable to so many casualties from weather, insects, etc., that absolute dependence cannot be placed on them for a small dairy. Swedes are not only better food than common turnips, but they taint the milk less readily, and keep much better. (13.) *Mangel-wurzels* are the best root crop for late winter and spring feeding of milch cows. Not more than from 40 lbs. to 70 lbs. should be given daily when they are the sole dependence along with hay and straw; but a smaller quantity, pulped and given with richer food, is better management, especially in butter dairies. Thirty tons of mangels per acre can be grown more easily than 20 tons of turnips on suitable soils, and in the following spring and summer they are better food per ton. (14.) *Kohl-rabi* is a hardy and useful crop on dairy farms, yielding, perhaps, 12 or 14 tons of bulbs, and a useful top as well, which cattle eat with relish. (15.) *Carrots*, especially the large Belgian sorts, can be grown with great advantage in a free soil; 10 to 12 tons are a good ordinary crop. They do not give a disagreeable flavour to the milk, and are extremely palatable to the cattle. Half a cwt. may be given daily with other food with great advantage. (16.) *Parsnips*, while not quite so palatable as carrots, are very nutritive, and extremely valuable for milk production. Of the large Jersey parsnips, 10 or 12 tons per acre have been grown. (17.) *Potatoes*, when steamed, prove an excellent cow food; they are sometimes used raw, but with less advantage; as compared with Swedes and mangels they are not economical. (18.) *Straw* of our various corn and pulse crops is used as winter fodder in the cow-yard. Cooked bean straw, if the crop has been well harvested and cut

before it was dead ripe, is nutritious fodder. Pea-straw, if free from mildew, is also good food; and clean wheat, oat, or barley straw with a few Swedes is often almost the sole fodder of dry cows and young stock through the winter; a pound or two of cotton cake should, however, be added. If straw is cut into chaff, and wetted with hot and salt linseed soup, made at the rate of about 1 lb. of the linseed to each head of cattle, and mixed with some pulped roots, store stock can thus be kept in very good condition through the winter. Next to good bean straw oat straw is to be preferred, but it should have been saved in good condition. Corn straw is the most valuable when it has been grown with seeds, a portion of which will have been cut with it. In any case a few turnips or mangels should be given to dry cows and growing stocks, or failing these 1 lb. to 3 lbs. of linseed or cotton cake, or a mixture of both. (19.) *Meal* of the various grains—wheat, barley, oats—or of beans, peas, linseed and Indian corn, is used more or less in cases where rich feeding of dairy cows is adopted. Bean, pea, oat and India-meal and bran are probably more commonly used than any other, and the first-named is especially fitted as food for cows in milk; a few pounds mixed with the daily rations is generally well repaid. It should be mentioned that cake is always a safer food than corn meal, especially that made from wheat or barley.

Linseed, ground or bruised, forms a useful addition to the steamed or boiled mess given to the cow. It may be given to the extent of 2 lbs. daily. A good plan where an engine and boiler are kept is to mix in a tank with one pail of water per cow, and cook it with the waste steam.

In this way it forms an admirable addition to chopped and pulped foods. (20.) *Cakes* made from the various oil-producing seeds are among the best of cattle foods. Linseed cake stands high on the list, as it is the most costly, but cotton-seed cake, produced from decorticated seed, has taken a very high place among our cattle foods. It must not be supposed that cake is specially adapted for the enrichment of milk in butter fat, and, therefore, for butter production solely on account of the high percentage of oil it contains. This oil has its value, assisting as it does in the maintenance of the condition of the cow; but it is the nitrogenous matter in the cake which places it above all other foods. Decorticated cotton cake, which has been shown by repeated experiments to be more economical than the common cotton cake, is perhaps the cheapest of all concentrated milk-producing foods, taking into account the high value of the manure produced from it. (21.) *Malt culms or sprouts* are a most useful milk-producing food, highly nitrogenous, communicating a most agreeable flavour and odour to chop, and usually moderate in price. (22.) *Molasses* are sometimes used for dairy cows, and 3 or 4 lbs., mixed with a quantity of chaff and turnips, induces a larger consumption of comparatively unpalatable food. (23.) Of all the foods used where cows are stall fed, none excels brewers' grains for stimulating the production of poor milk: from 2 to 4 pecks daily are given to each cow. By gradually mixing a little with their ordinary ration, they will ultimately take them greedily. Grains from the smaller breweries are believed to be the best. They are used largely in town dairies. They diminish in value, however, with every

improvement in the processes adopted for extracting the most nutritive parts in brewing or distilling. Grains are now dried, and in this form they are rich in fat and albuminous matter, and are likely to become popular in country dairies; by soaking in water they are easily brought to the condition of wet grains. (24.) *Salt* should be placed within reach of the cow, and a lump in her manger is perhaps better than the direct addition of so many ounces daily in her food. Salt encourages the flow of saliva, and thus stimulates the conversion of starch into sugar.

We must not forget to mention what is virtually a new source of succulent food in winter, the practice of ensilage. Green grass, rye, vetches, or clover is packed tightly in pits or stacks, and kept under a pressure of 1 cwt. or more per square foot of surface; thus preserved, it is a perfectly palatable food for dairy stock, and is available all through the winter. Mr. Kirby, of Hook Farm, near Bromley, showed us how he fed more than 100 cows on the contents of his silos, in which mown grass cut the previous June had been cut into chaff, and packed and pressed. And this is now a not uncommon experience. Cows fed on 50 lbs. of grass silage, some grains, 2 or 3 lbs. of cake, and as much meal, yield abundant milk of admirable quality. In filling a silo the grass is well trodden as *it is filled;* when full, dry earth or sand is laid over the surface to the required depth and weight, and the work is done. To prevent it coming out sour, however, the silo is *gradually* filled, the temperature being allowed to reach 130° before pressure is applied. Silage thus made comes out sweet and fragrant, but in all cases, in its

conversion, the grass has suffered a loss of feeding matter.

The Cropping of Land for the Cow, notwithstanding the variety of foods available for her use, is generally a very simple matter. Almost all the butter and cheese produced in this country is made from cows which are fed upon grass in summer, and upon hay, roots—*i.e.*, turnips and mangels—and straw, with the addition of cakes and meal, in winter; while the milk supplied by town-fed cows comes from brewers' grains, together with cabbage, cut vetches, and clover in summer, and hay, mangel, and similarly concentrated foods to the above, in the winter. There is, however, room for a great deal more economy in the utilisation of the dairy farm, by adapting the arable portion more directly to cow-feeding, and so enabling the occupier to keep a larger stock of cattle. Let us take an instance or two of small farms available for dairy management, and see how far arable crops enable us to increase the stock of dairy cows beyond the "one to every three acres," which is the average of our ordinary dairy districts. The following paragraphs describe actual cases in which the advice of the writer was applied for:—

(1.) "*Hill Side*" had 15 acres of poor grass land and 35 acres of arable land, 5 of which were in sainfoin. Let us see how many cows the occupier could keep. The 20 acres of grass and sainfoin may be supposed to yield 200 tons of green food; and of the 30 acres of arable land, 20 acres in clover, mangel-wurzel, carrots, parsnips, and Swedish turnips, might produce annually nearly 400 tons; while the remaining 10 acres in grain

crops would produce, say, 15 tons of straw: 580 tons of food, at 120 lbs. each per day, would keep 20 or 25 cows throughout the year, and 15 tons of straw would litter them in winter. This calculation is based upon data which will be found true, whether the grass be made into hay or not. The following is a rotation which would bring out the quantities and kinds of produce suggested. Let half the sainfoin and nearly half the grass land be mown each year, and 5 acres of the arable land be in clover, to be cut and carried to the cattle in the house. The 30 acres of arable land may be divided into 6 fields of 5 acres each. 1st year, corn sown with clover seeds; 2nd year, clover; 3rd year, swedes; 4th year, corn; 5th year, mangel-wurzel; 6th year, carrots. Vetches or rye might be taken after a portion of the clover lay and cut in time for white turnips.

		Summer food.		Winter food.
5 acres of clover		60 tons.		—
5 „ swedes		—		100 tons.
5 „ mangel-wurzel ...		80 „	and	80 „
5 „ carrots		30 „	„	30 „
5 „ sainfoin		30 „	„	30 „
15 „ meadow		80 „	„	60 „
		280		300

Of course the 60 tons of grass produce put down to the column of winter food is given as hay, but that does not affect its valuation as food. Here, then, by the aid of arable produce we might be able to provide daily food throughout the year equal to the maintenance of a herd of 20 to 25 cows on a poor farm of 50 acres if it were well manured and managed. A medium farm of 50 acres, wholly of pasture, would not, as a general

rule, keep more than two-thirds of the stock for which food is thus provided. The crops suggested are heavy, but land liberally cultivated under such a rotation ought to yield well. In this, as in similar cases, great help to the crops as well as to the cattle would be afforded by the liberal use of cotton cake and other such foods, and the careful protection of the liquid and solid manure.

(2.) The following is the case of a dairy farm of 35 acres of meadow and 25 acres of arable land:—The cows are stall, box, or shed fed during the winter and during part of spring and autumn. Let us suppose them to be under shelter 200 days in the year. Each cow must have about 8 lbs. of litter daily; she may be kept fairly comfortable with this quantity, although it is certainly a scanty allowance; she will thus require 14 cwts. per annum, so that 25 cows will require about 17 tons—a quantity which may be supposed to grow on 12 acres, the half of the arable land.

The arable land, then, may be cropped thus:—

1 acre of lucerne.
12 acres of grain crop, or 6 of wheat and 6 of oats.
6 acres (after wheat)—2 of mangels, 2 of Italian rye-grass (or trifolium), and 2 of vetches.
The two latter succeeded by 4 acres of swedes.
6 acres (after oats)—3 of mangels, and 3 of carrots.

Of the pasture land:—

18 acres may be mown, and
17 acres depastured, each year.

The following, accordingly, will be the produce of

green food for consumption, besides the straw of the 12 acres of grain:—

18 acres of hay, equal to 30 tons of hay; which may be considered equal in green food to	120 tons
18 acres of aftermath, equal to	60 „
17 acres depastured, equal to	190 „
1 acre of lucerne, equal to...	16 „
2 acres of Italian rye-grass (or trifolium), equal to ...	20 „
2 acres of vetches, equal to	20 „
5 acres of mangels, equal to	140 „
4 acres of swedes, equal to	75 „
3 acres of white carrots, equal to...	36 „
Or in all	701 tons

a quantity equal to nearly 2 tons of green food a day, which will keep 26 to 30 cows very well. And the crops may all be used in proper season. Beginning with October, till February the cows will be feeding on grass (except during severe weather), carrots, swedes, and hay; till April, on carrots, mangels, and hay; till July, on grass, mangels, rye-grass, vetches, and hay; during summer, on grass in the fields and lucerne. Some growers will be tempted to take a second cut of rye-grass, but the swedes will prove the better crop, both as an immediate food and as a preliminary to grain. Where swedes cannot be got in after rye-grass and vetches, turnips or cabbage (also an admirable milk-producer) can. In the southern counties trifolium incarnatum may be followed by swedes, turnips, cabbage, and rape. In addition to this stock, two horses will be kept, and food must be provided, or displaced, for them by the purchase of 40*l.* worth of oats and hay. It is plain that other crops

might have a place in the scheme. Cabbages which admit of transplanting in a forward stage of growth from seed-beds to any land from which the crop has just been taken, will be certain to have a place on such a dairy farm, especially in filling up all gaps in the root crops.

These instances will be considered cases of high farming; but the ordinary experience of dairy farmers, who only keep one cow to every three or even four acres of pasture, is more generally improved upon in a less vigorous way by the cultivation of a few acres of roots, in order to economise the winter's consumption of hay, to render less hay-making necessary, and to make more acres of the pasture available for summer feeding; thus providing for more cows on summer grass, which is the most productive of milk, although the milk is worth less per gallon.

A large crop of food may generally be taken by planting cabbages after vetches or trifolium, before turnips go in, for autumn and winter consumption, or after early-cut oats, for consumption in spring; although much depends upon the part of the country in which the farm is situated. Vetches should be sown in successive patches, in order to yield a succession of food during the summer months; but it should be arranged for the early vetches to be sown in autumn, preferably after the winter oat crop, and the late ones in spring. There is no time for a second crop after the latter, if the ground is to be occupied during the following year by corn; otherwise cabbage plants may be advantageously planted. In the southern half of England, maize, producing from twelve to twenty tons

an acre, may be successfully sown in the first ten days of June, four years out of five, for cutting in September and October; thus materially assisting in extending the desirable system of double cropping. Maize is not only a bulky crop, but containing a large percentage of sugar it is much relished by the cows, which eat it greedily. Moreover, it is, with the exception of lucerne, which can only be grown upon selected soils, the only forage crop which grows luxuriantly during drought, thus affording abundance of food when the pastures are bare, and the farmer is in extreme difficulty as to how to feed his cattle. It requires liberally feeding with dung, and is most easily grown, 1½ bushels per acre being strewed in every other furrow after the plough. It must be harrowed and well rolled in. Drilling and broad-casting are useless methods of sowing, as the rook will at once take the seed; and for this reason precaution is necessary when the young plant first appears.

CHAPTER III.

CHOICE AND TREATMENT OF THE COW.

Dairy Breeds: Shorthorns, Red Polls, Jersey, Guernsey, Ayrshire, Dutch, and Kerry—Individual Character: Age, Form, Other Characteristics—Treatment of Cow: Housing, Health, Winter Milk, Diseases, Milking—The Calf: Rearing and Feeding.

THE various breeds of cattle known to English agriculture, and their ordinary management, have been already described in a "Handbook on the Live Stock of the Farm," but it is necessary that such peculiarities of breed, age, and individual character should be referred to as ought to guide the choice of the purchaser.

The Dairy Breeds of Cattle.—Of the many distinct breeds of cattle cultivated in the United Kingdom, only six can be enumerated as strictly dairy breeds. Among these are the Shorthorn, the Red Poll, the Jersey, the Guernsey, the Ayrshire, and the Kerry.—(1.) *The Shorthorn* is the principal dairy breed of these islands. In Gloucestershire there was, and still is to some extent, a dark red, or brindled cow, of medium size, with almost black extremities, though sometimes with a streak of white along the back: but it is now becoming rare. In Cheshire also there was a native breed more or less resembling the Lancashire and Midland Counties Long-horned breed; but either by substitution or by

crossing, the Yorkshire cow, essentially a Shorthorn, is displacing it. This, therefore, is at present peculiarly the milk-producing breed of the country. Its improvement as a milker has been marked during the present decade, and its capacity to yield milk, butter, or cheese is greater than that of any other cow bred by British farmers. Elsewhere the Devon, a much smaller animal, yields a lesser quantity of milk, although this is of high quality; the Hereford, an animal of nearly equal size, is also deficient in its yield, and in neither of these counties does the prevalence of a peculiar breed produce anything like a general and important dairy husbandry. The London milk dairies are almost exclusively composed of the Shorthorn cow, and excepting in Suffolk, Ayrshire, and the Channel Islands, it is extending more or less into every dairy district of the country. It has the advantage over all other breeds, that its calves make more valuable oxen, and its cows, after five or six years' milking, are more easily turned into beef. The milk, compared with that of other dairy breeds, is remarkable rather for quantity than quality, and therefore it is adapted either for direct consumption or for the production of cheese, rather than that of butter; yet the London Dairy Show trials have shown that the milk of many Shorthorns is of exceptionally high quality, and that by carefully selecting stock, a high-class butter-making herd could easily be formed. Good Shorthorn cows are now offered for sale in almost every considerable market in the kingdom. The northern fairs, however, as those of Yarm, Northallerton, Darlington, and Newcastle-on-Tyne, furnish an excellent choice. Northampton, Stow-in-

the-Wold (Gloucestershire), and the best markets in Bucks, Derbyshire, North Lancashire, and Westmoreland are also noteworthy. The best young cows just calved are worth from £22 to £30 a-piece: prices, however, vary from year to year.

(2.) *The Red Polls of Norfolk and Suffolk*, a hornless red breed, are of great excellence for the dairy. Like all good dairy cows, they are narrow and small before, compared with the development of the hind-quarters. They are good milkers, and as the Suffolk dairies are mostly managed for the production of butter, the milk is of excellent quality. The Suffolk Poll probably yields as large a quantity of milk in proportion to its size as any other breed in England, and it therefore deserves more attention, as furnishing suitable animals for small home dairies, than, except in its own district, it has received. The polled Suffolk cow is purchasable at almost any of the fairs in Suffolk and the adjoining county of Norfolk.

(3.) The *Jersey and the Guernsey* breeds, in which faults as fattening stock and merits as milk-producers are combined, are the favourites of the small or household dairy. The great, almost deer-like beauty of the head, and, indeed, in the well-bred Jersey, of its whole form, makes it an ornament to the park or paddock; the unexcelled richness of its milk enables it to meet a demand for cream; and its small size makes it at once less mischievous in winter in the field, and more easily managed in the house. The quality of the milk is so good that not unfrequently one (or more) of this breed is kept even in large dairies, where the large-framed Shorthorn forms the majority of the herd, for the sake of the

enrichment of their produce by the mixture of its own. The best fairs at which to purchase Channel Island cows are held on the islands themselves. Sales by auction are, however, almost weekly advertised in the London papers, where these and other imported breeds are offered. The price reached is 20 guineas, and higher, for well-bred young stock. The fawn-like Jersey has an equal rival in the yellow and white Guernsey, a larger cow, yielding as much or more milk of an equal quality, with a frame and character better calculated either to carry beef or to admit of crossing with other beef-producing breeds.

(4.) *The Ayrshire*, though too small for the most productive pastures of our English dairy districts, and involving, owing to the great number that must be kept on a given extent of ground, more labour than the larger dairy cattle there prevalent, is one of the most useful dairy animals we have. It possesses, more perfectly, perhaps, than any other variety, the external features which a good dairy cow ought to exhibit, and withal it displays a greater aptitude to fatten than either of the other small dairy breeds. It yields a remarkable quantity of excellent milk, which, if less rich than that of the Guernsey or Jersey cow, is better adapted for economical cheese-making. It is generally red and white, small boned, with light fore-quarters, and with longish horns gracefully set on the head. Good Ayrshire cows are to be obtained at all West of Scotland fairs and markets. The best bred animals have a "fancy" price, and as much as 18*l.* to 25*l.* are asked for good young cattle in milk.

(5.) *The Dutch*, a large black and white breed, large

horned and somewhat ungainly in appearance, has a great reputation, both in this country and America, for its large yield of milk, which, however, is often of poor quality. The Dutch cow is most carefully bred in Holland, the herd-books being kept with jealous carefulness. At the Amsterdam International Exhibition in 1884 we saw a few cows which had recorded phenomenal yields, although no animal in the milking classes showed anything unusual by her performance. Cows have, however, been frequently imported into England which have given over 1,000 gallons of milk in a year, although in many cases their subsequent yields have been much less satisfactory. It seems, however, to be reserved for American breeders to achieve the best results with this breed, for they have frequently recorded 1,500 gallons in a year, and in some instances over 2,000 gallons. One cow, Parthenia, a six-year-old, has a record of 548 lbs. of milk and 35½ lbs. of butter in seven days, an average of nearly 8 gallons per day.

(6.) *The Improved Kerry* breed of cattle is remarkable for its small size and comparatively large yield of rich milk. This character it possesses in common with other small and mountain breeds of cattle. The Anglesea breed, for instance, a race of black cattle, are often spoken of as deserving more attention for the dairy than they receive; and the small Breton cow is another of the same class, which was imported in considerable numbers for household dairy use, before the exclusion of live cattle from France. None of these breeds are, however, comparable with the Ayrshire, the Suffolk, or the Channel Island cow for

such purposes, and still less can they compete with the Shorthorns for use on large dairy farms. Selected Kerries of the improved type, however, are far superior to the Kerries of the Irish farms, and are worthy of the attention of owners of small dairies.

Age and Individual Character.—These are the features which should chiefly guide the purchaser of a cow. The breeds that have been named will assist him in making a choice, simply because in them individual character does receive, to a certain extent, a classification. Thus, the characteristics of a cow embrace such particulars as size, docility, form, aptitude to fatten, and proved productiveness as to milk; but the cows of any given breed more or less resemble one another in all these points, and a reference therefore has been made to those particular breeds in which, as regards fitness for the dairy, the combination of all these qualities is best. It is, however, the actual possession of these characteristics in the individual, and not the fact of its belonging to a dairy breed of acknowledged excellence, that constitutes its merit; and it may be well, therefore, to point out those particulars with which excellence for the dairy is generally connected. (1.) As to *age*:* there is nothing more unprofitable than an old cow. In the ordinary practice of the dairy, unless a cows aborts or becomes barren, she is kept probably five or six years in milk, being sold when eight or nine years old;

* For indications of age, and many other particulars not specially called for in a Handbook of Dairy Husbandry, see "Handbook of the Live Stock of the Farm"—(Vinton and Co.).

this is the general practice, simply because at that age the quantity, as well as the quality, of her milk falls off so much, that it is better to replace her with a younger animal; but as a cow is sometimes of such first-rate quality as to induce her owner to keep her as long as she will breed, so oftentimes it is well to part with an inferior cow after a year or two's experience of her. The cow is generally at her prime after her third or fourth calf. In Ayrshire, when cows are let to dairymen, three heifers with their first calf are estimated as equal to two cows. (2.) As to *form*, a good cow, of whatever size, is generally lighter in her fore-quarters than behind; she should be especially wide and deep at the loins, her skin should handle thin and soft, her udder should be of full size, broad, reaching well forward, and back between the hind legs; it should not be baggy, but level with the base of the stomach, and fine and silky to the fingers; the teats should be placed symmetrically on it, neither too close nor too wide apart, and it should be ascertained that they are all perfect—that the cow has not, as it is said, lost any of her "quarters." This would really constitute a loss of one-quarter of her milk; for the udder is not a bag from which the teats are four common outlets for the fluid it contains. Each of these outlets has connected with it a separate apparatus for the secretion of milk; so that, on the one hand, if one fail or be diseased, wholesome nourishment for the young may still be obtained from the others; but so also on the other, that the loss of a teat is equal to a real loss of one-fourth the milk-producing ability of the animal. The milk veins in connection with the udder

should be prominent and large. The head should be rather long and narrow, except at the muzzle, and the neck rather thin than otherwise; the extremities generally should be fine. (3.) Among *other characteristics* of a good dairy cow, quietness and docility of temperament is a point of capital importance.

In selecting a young cow attention may often advantageously be paid to the milking capacity of her dam and the "milking blood" of the sire, if details are known and can be obtained.

Treatment of the Cow.—The proper treatment of the cow in milk, which has been separated from its calf, consists simply in giving it suitable food and water at regular times, allowing it sufficient exercise for its health, keeping it clean and warm, and milking it properly and regularly. The subject of food has been already sufficiently discussed, and the necessity, especially when comparatively dry food is given, of an ample supply of water being allowed, has been insisted on. Where the animal is house-fed, it should be fed on succulent and dry food alternately, and at least four times a day, allowing ample intervals for rumination. In any case she could be allowed access to a pasture or a yard for exercise during the middle of the day in winter, and early and late during summer. But it is of course much the better plan, where possible, to have daily access to the pasture field for food as well as exercise all the year round. (1.) The *cow-house* may be an enclosed shed with a trough along its inner side, and upright posts every $6\frac{1}{2}$ to 7 feet, carrying a sliding ring and neck strap, by which two cows are attached

each to its place; this shed should be open to the south, and entirely closed against the weather by both window and door, in winter. Or it may be a series of "boxes," which may be 9 feet square, or 8 feet by 10, in which the cow remains during the winter season, being littered daily, rising in her lair by the continual addition of the hard-trod straw and excrement. The trough in this case must be capable of being raised as the floor of the box rises, and if it be hung on two pins at each end between two uprights, bored every three inches or so to receive these pins, this raising can easily be effected; and there will be this additional advantage, that by withdrawing the upper pin at either end after the food has been consumed, the trough will turn over bottom upwards, so as to hinder the cow from dirtying it. If cows are confined permanently in this way, water must be "laid on" to troughs to which they have access. Much the most common cow-house, however, is that in which a double row of cows is tied in couples to a long manger at either side, leaving a wide interval or passage in the centre for the easy removal of the dung and the easy handling of litter. A sufficiency of straw for warmth and cleanliness must be provided; 10 to 15 lbs. a day a-piece will be needed in the boxes: rather less will suffice for stalls. Some farmers, however, use no litter, the cow standings, usually made of dry earth or chalk, being very short, as in Holland, with gutters behind into which the manure falls. Others use peat litter or sawdust. The best mangers are of semi-circular glazed hardware, laid with the upper rim 9 inches above the floor. The stalls should be 5 feet to 5 feet 6 inches long, the gutters 5 to 6 inches deep by

10 inches wide, with a curb of grooved firebrick. Except in feeding-boxes, the dung should be removed at least every morning and evening, and fresh litter supplied at night. Where oat straw is given as food, sufficient will usually be left for litter. It is an additional security for cleanliness, and a comfort and advantage to the animals, if they are occasionally curry-combed. In all cases ample space and sufficient ventilation should be provided, and at all times, of course, kind and gentle treatment must be insisted on. An animal so sensitive as a cow, whose produce is dependent so much upon its health and even temper, abundantly rewards quietness, and punctuality, and liberality of treatment. On the subject of patience and gentleness in dealing with the cow, it may be well to add that they are especially needed in dealing with a heifer rearing her first calf, and just commencing to be milked, and with the calf itself from first to last.

(2.) *Health.* The cow goes with young nine months and a week, or thereabouts. Of 760 cows, whose period was observed by Lord Spencer, 600 calved between the 279th day and the 291st day, and the births were pretty evenly distributed over the intervening period, reaching a maximum about the 284th day. 314 cows calved before the 284th day, and 310 cows calved after the 285th day; and it is noteworthy that a larger proportion of bull calves came at late births, and a larger proportion of cow calves at the earlier births. Thus of 381 calves dropped after the 284th day, 233 were males and 148 females; and of 294 calves dropped before the 284th day, 135 were male and 159 were female. On the whole, the number of males produced by this very

large number of cows was considerably above that of females.

Of abortion it may be mentioned that while sometimes, owing to accident or ill-health at the time of its occurrence, it is not often (probably not at all) produced by eating ergoted grass as is popularly supposed. The disease is now believed to be the work of an organism communicated by infected cattle, and the greatest care should be exercised in the introduction of new cows into a herd in consequence. In cases of abortion, the animal (which should at once be isolated), together with those in the same house with her, should be disinfected by well syringing the vagina with warm water, in which carbolic acid (1 in 50) has been mixed. A bull should never be allowed to season a cow which has aborted; should he do so, the sheath should be well disinfected by syringing with the dilute carbolic acid. The fœtus, after-birth, and discharge from an aborting cow should be burned or buried in lime, and the stall or shed in which the animal has stood should be thoroughly cleansed and disinfected before it is used for any other cows. Abortion is clearly infectious, and may run through an entire herd, unless vigorous treatment is adopted directly it appears. As a cow which has aborted once will probably do so again, the best plan is to at once prepare her for the butcher, even while milking.

In the ordinary practice of our dairy districts, where it is desired that the cows be in full milk, and their calves be all, or nearly all, weaned by the time they turn out to grass, it is common to let the bull run with them from the end of May or thereabouts.—*Winter Milk.*

When a constant supply of milk, whether required for the market or for use in a household, is to be supplied continuously throughout the year, it is necessary either to have spring and autumn calvers, or to replace dry cows by those more recently calved. The cow should be dried at least six weeks before calving. Simply but gradually ceasing to milk it is sufficient for this purpose. The parturition of the cow generally takes place without any need of assistance, but in case of difficulty a properly-qualified practitioner must be called in, hence the importance of the cowman being in attendance. Before calving, the cow, unless in poor condition, should for a few weeks be placed on poor pasture, except in winter, when her ration should be simple in the extreme, but immediately afterwards she may receive warm mashes twice a day, with her usual food for two or three days; these are made simply by pouring boiling water over bran—a peck or thereabouts at a time—and letting it remain until cool enough to give it as food. Steamed turnips may be mashed up with it, and a pint of oatmeal will make it still more nourishing. In calves the "*husk*" or "*hoose*," a cough produced by worms in the windpipe, is prevented by good water and sufficient food, and keeping them from damp grass to which the sun does not penetrate; it may possibly be cured by lime-water, "half a pint daily," or turpentine in linseed oil, "one ounce in four, once a week." This should be taken along with entire change of food, as, for instance, removal to old sainfoin in an upland district, and an allowance of linseed cake. —*Quarter-ill* is another disease of young animals, causing almost sudden death, often owing to change of

food or exposure to cold. It is best prevented by uniform treatment as to feeding, and warm and comfortable housing.—*Hoven*, in which the stomach is distended by the gases produced during imperfect digestion, is the consequence of greedy or rapid feeding on too succulent food. An ounce of ammonia in a pint of water will greatly relieve; if not, the left flank is sometimes stabbed downwards between the hip bone and rib, and the gases liberated, a "trochar," leaving a "canula" in the wound allowing the passage of the gas, being used for the purpose.—*Purging*, or scour, in calves is generally treated by a drachm or two of carbonate of soda, given in warm milk, which helps to dissolve the indigestible curd in the stomach. A commonly successful remedy is to give castor oil, which often removes the troublesome secretion at the onset. There should be no delay in the treatment of scour, for cure is hopeless when it reaches a certain stage.—*Red-water* is a disease of the liver, accompanied by scouring, and dark-coloured urine; the medicine should contain calomel and Epsom salts.—The *drop after calving*, a paralysis, is prevented by allowing the cow sufficient exercise, and keeping her in good health before calving. In suspected or fleshy cows, there is no better treatment than that of turning them into a poor pasture when dried, and allowing them to calve there. A drench of Epsom salts, ½ lb. dissolved in warm water, and given twenty-four hours before calving, is effective.—*Foot-and-mouth disease* is accompanied by sore feet and blistered mouth.—And *Pleuro-pneumonia*, an infectious disease of the lungs, necessitates notice to the authorities, who prescribe

somewhat severe treatment.—*Diseases of the skin*, as ringworm and lice, are to be avoided by cleanliness and curry-combing, also by good feeding, which keeps the animal in vigorous health, and able and willing to clean itself; insects may be destroyed by thoroughly rubbing in tobacco-water, or carbolic soap-suds; but ringworm requires persistent dressings with mercurial ointment.

When, owing to any wound or disease in the teat, blood appears in the milk, the teats should be well fomented with warm water, milked with gentleness, and the following ointment applied to them:—Palm oil 3 ozs., yellow wax 1 oz., acetate of lead 2 drs., alum 1 dr.; to be well incorporated together, and applied daily after milking.—Warts on the udder, which are often a great nuisance, are removable "simply by the knife or cautery, or ligature when the cow is not in milk." It must suffice to add here that for some of these short notices, the value of most of which has been verified in our own experience, we are indebted to Mr. W. C. Spooner; and we conclude as we began, by advising that, except where mere nursing will suffice, the veterinary surgeon be consulted.

(3.) *Milking*. On the right performance of this operation depends a good deal of the produce which it obtains. It should be effected gently, quickly, and perfectly—the first because everything that soothes the animal is beneficial, the last both because the milk-secretion is thereby unchecked, and because the last-drawn milk is much the richest. The whole subject, however, was so well treated in a paragraph which appeared some years ago in the *Ayrshire Agriculturist*, that we extract it here:—

"The milking of cows resolves itself naturally into two heads, viz., how to milk, and when to milk. If every drop of milk in the cow's udder be not carefully removed at each milking, the secretion will gradually diminish in proportion to the quantity each day left behind. But another reason why every drop of milk should be taken away is to be found in the well-known fact that the last milk is doubly as good as the first milk—hence, if not removed, there is not merely equal, but double loss. Milking should be conducted with skill and tenderness—all chucking or plucking at the teats should be avoided. A gentle and expert milker will not only clear the udder with greater ease than a rough and inexperienced person, but will do so with far more comfort to the cow, who will stand pleased and quiet, placidly chewing the cud, and testifying by her manner and attitude that she experiences pleasure rather than annoyance from the operation. Cows will not yield their milk to a person they dislike or dread. The ordinary practice is to milk cows twice daily—at about five o'clock in the morning, or in winter as soon after daylight as possible, and again at the same hour in the afternoon, thus leaving twelve hours' interval between each milking."

It should be added that cleanliness in milking should be observed—the hands should be clean and the udder too. In practice, milkers neither wash their hands nor the udder of the cow, but a good milker—that is, one who does not wet his hands with the milk when milking—will milk a dry udder without dirtying the milk, even though the udder be not perfectly clean. In large dairies milking lasts about an hour each time, and ten to twelve cows are allotted to each man or woman.

The Treatment of the Calf, when intended for veal or for beef, has been already discussed to some extent.* When the heifer calf is reared for dairy purposes, less forcing food is required and even desirable. Ample exercise, too, is necessary. The rules to be observed are to give the milk, whether it be new or skimmed, of the natural temperature, to be obtained by warming a portion of it before mixing with the rest, and perfectly sweet; to take care that calves are brought into shelter at night, at least till June and again after September, and to keep them together in a field. After a few days they are fed from the pail, by getting them to suck the fingers under the surface of the milk; giving them at first two quarts a-piece in the morning, and two quarts a-piece at night; and it is well to tie them up for the purpose, and to let them remain tied up for twenty minutes or more after being fed, else they take to sucking and plaguing one another. A little hay in a network bag is hung here and there in the calves' house, that they may learn to suck and eat it. During the first winter, a little hay chaff is given, mixed with pulped mangel or swedes and a little linseed cake. The ensuing summer is spent in second year's clover, grass, or old sainfoin as pasture, and in the case of the more precocious breeds the heifers are often put to the bull at sixteen months old. They are fed during their second winter on a full allowance of roots and straw, with a little good hay and cake in addition. To keep up a herd of dairy cows, about one-fifth their number of heifer calves must be reared each year; these are

* See "Handbook of the Live Stock of the Farm."—(Vinton & Co.)

almost invariably selected from the calves of the herd, the remainder being sold as soon as possible after birth. If, however, it be desired to rear heifer calves for sale as young cows, it is good policy to purchase them from the best herds, even though £3 a-piece is paid for what elsewhere would not cost one-half as much. Taking them in succession, a couple at a time, several calves may very well be reared in the course of the season on the milk of a single good cow, with the assistance of hay and linseed cake. It is well to leave the calf with its mother for a week or two in the case of young cows; they are better milked by their young; and if carefully stripped in addition at least once a day by hand, are likely to yield more milk, and to yield it more easily in the future than if the calves be taken away early, as they may from older cows.

Some breeders who rear by hand, wean the calves at birth, and give new milk for ten to fourteen days; after which skim milk is introduced, until, by the aid of boiled linseed, new milk is altogether knocked off. We have also seen excellent results obtained by giving older calves curdled skim milk, as much as they will take twice daily. Indeed, they may be prepared for the butcher upon this food, to which they easily become accustomed, and of which they will consume a large quantity.

CHAPTER IV.

MILK.

Composition—The Dairy—The Taste of Milk—Adulteration.

The Composition of Milk.—Milk is essentially an emulsion of fatty matters in water containing albumin, casein, and sugar in solution, together with a small quantity of mineral matter. Its fat is suspended within it in the form of globules, varying from $\frac{1}{1500}$th to $\frac{1}{12000}$th part of an inch in diameter, averaging about $\frac{1}{5000}$th of an inch. If the milk be kept at rest, these globules will rise to its surface, and with a portion of the milk form a coating of cream which, being violently agitated, separates into butter and "butter-milk," the latter containing the same constituents as milk itself, although in different proportions. The composition of milk, in so far as these buttery globules are concerned, is ascertained in various ways. The *lactometer* is intended to show the specific gravity of milk, and consequently its purity. Pure milk varies between 10·28 and 10·33 at 60° Fahr., so that if watered or skimmed its density becomes lighter or heavier. As, however, its density may be maintained at its normal figure by both skimming and watering, it is evident that without concurrently testing a sample for cream in what is termed a *creamometer*, the lactometer is not reliable; it does not indicate the percentage of fat. For this purpose there is no simpler plan than that known as the Marchand system, in which a measured quantity of milk is mixed and well shaken with ether, and sub-

sequently with alcohol, in a glass tube, and plunged in a hot-water bath at 104° Fahr., when the fatty solution rising to the surface indicates the percentage of fat present. Soxhlet's aërometer, a more delicate process, is still more precise; whereas the lactocrit, of Laval, and the control apparatus, of Fjord, are both excellent for use in connection with the Swedish and Danish separators. Tests depending upon the opacity of milk are less reliable, and are now seldom adopted. The actual composition of milk can only be ascertained by analysis, but the churn will always roughly indicate the quantity of fat present in milk, and cheese rennet will remove the remaining curd.

The liquid remaining after the manufacture of cheese is called whey. It contains the bulk of the sugar which was present in the original milk, together with small quantities of fat, casein, and mineral matter.

The milk of different animals varies in composition, as will be plain from the following table:—

Ingredients in 100 parts.	Composition of Milk.							
	Woman.		Cow.		Ass.	Goat.	Ewe.	Mare.
	1.	2.	3.	4.	5.	6.	7.	8.
Albuminoids	1·54	2·9	3·40	3·70	2·22	4·08	6·31	1·95
Fat.....	4·37	2·3	3·40	3·60	1·64	3·32	6·83	1·06
Sugar	5·75	3·8	4·80	4·75	5·99	5·28	4·73	6·29
Ash	0·53	—	0·75	0·70	0·51	0·58	81·31	0·39
Water	87·81	91·00	87·65	87·25	89·64	86·80	0·82	90·31
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

The term albuminoids includes casein and albumin. Of these analyses, No. 1 is by Dr. Lyon Playfair; 2 is

the average of two analyses by Haidlen; 3 is by Fleischman; 4 is the mean of a number of analyses, 5, 7, and 8 are the averages of many analyses published by the New York Dairy Commission.

As regards the milk of the cow, it differs in composition, as has been already said, according to the breed, age, and food of the animal. Thus, the first-drawn milk produced during the labour and excitement of parturition contains an extraordinary quantity of casein, and is otherwise different from ordinary milk; it is no doubt naturally beneficial to the calf in the first day or two of its life, during which time the milk not used by it and drawn from the cow is generally rejected for any purpose but the feeding of pigs. The milk of a cow increases in quality as she approaches the period for drying off; thus a cow calving in March yields milk of much superior quality in September. Again, the milk first drawn from the cow is much poorer than that last drawn, for whereas the first glass may contain only 5 per cent. of cream, the last glass may contain 20 or even 25 per cent., unless the hours of milking are kept twelve hours apart, or approximately so. The milk of the evening is generally richer than that of the morning.

The following table gives the results of numerous analyses of ordinary cow's milk:—

	Fat.	Solids not Fat.	Total Solids.
Shorthorn (88 cows)... ...	3·71	9·16	12·87
Jersey (75 cows)	4·04	10·00	14·04
Guernsey (35 cows)	4·65	9·44	14·09
Red Poll	4·08	8·82	12·90
Ayrshire	4·22	8·90	13·12
Dexter Kerry	4·99	8·94	13·93

The foregoing are the results of nine years' milking

trials of the British Dairy Farmers' Association, at Islington.

These tables, together with the intimation that casein, the essential matter of cheese, is soluble in alkaline solutions, as in milk—that the butter of milk is a compound of several fatty matters of different compositions, and produced in various proportions, in accordance with the food consumed and the temperature of the period—that the sugar of milk is capable of transformation by the mere rearrangement of its elements into a substance having acid properties, and therefore called lactic acid—that this rearrangement is effected by the presence of a ferment, itself the active agent of decomposition—that, in fact, any substance in contact with it, undergoing chemical transformation and decomposition, and air carrying filthy odours, the product of such decomposition, are sufficient to destroy its purity—that the curd of milk itself, in the presence of warm air, undergoes such chemical transformations, must for the present suffice on the subject of the composition of milk.

The preservation of milk in its natural composition, and therefore in its sweetness, may be effected by heating it in hermetically closed bottles or metallic vessels up to the boiling-point. This sweetness, however, may be prolonged even when exposed, by the use of chemical preparations, some of which are employed by retailers during very hot weather, but the custom is believed to be pernicious, and cannot be recommended.

Condensed milk—that is, milk which has been subjected to evaporation so that more than one-half its water is dissipated, and the whole reduced to a thickened

tenacious mass—is now largely manufactured, and is especially serviceable for use on shipboard, as it will keep fresh for months. It usually contains a large percentage of cane sugar.

For the period during which milk is kept for the natural rising of its cream, its sweetness is maintained simply by keeping it cool in perfectly clean vessels and pure dry air. It is in this way that chemical changes are held in check. If the dairy is warm, the milk will coagulate before the cream has all risen. If it is cold, the cream will rise too slowly.

The Dairy.—In order to keep milk sweet, and for the proper management of the processes which its manufactured products undergo, certain rooms must be set apart expressly for the purpose. The milk-room should be cool, for the reasons just stated; and a somewhat sunken floor, a shaded or thatched roof, and an aspect to the north and east, are therefore desirable. Where the old system is adopted, the vessels to hold the milk are arranged on slate shelves. The floors are better of stone, hard tiles, or concrete, than of wood, these materials being less absorbent, whether of milk, dirt, or damp, all of which may encourage the presence of ferments. The room should not be contiguous to either drain or dungheap; it should not be near any food store, whether the larder of the house or the feeding-stalls of the farmery. The air which enters it should, if possible, be free from the taint which the neighbourhood of stock or manure more or less produces. The drier, too, the air is, the better; and therefore a setting dairy should be kept clean by keeping out the dirt,

rather than by too frequent washing. Practically, however, the floor and shelves of the milk-room are kept clean by washing. By strict attention to cleanliness and ventilation, and by as far as possible excluding a summer temperature, those causes—warmth and humidity—which tend to encourage the presence of ferments are excluded or held in check, so that good butter or cheese can be made.

The Flavour of Milk may be affected by food given to the cows, and in its turn communicated to the butter and the cheese made from it. It sometimes occurs, when the cows are grazing, and when such disagreeable plants as wild garlic have been eaten. It is, however, chiefly noticeable during winter-time, when cows receive turnips and cabbages in abundance. To some extent the flavour may be prevented by cooking the food to which it is owing; a mash of steamed turnips, chopped hay, beanmeal, oatmeal, and linseed, will produce perfectly sweet milk. Among the various devices adopted for removing ill-flavours from milk we may add the following. Where turnips are the cause, reduction in the quantity given; removal of the crowns in which the bitter flavour will be found; the careful removal of all stale bulbs or tops; change of food. Sometimes a little saltpetre is dissolved in water, and a dessert-spoonful added to every gallon of the milk, or some fine white sugar may be dropped into each setting-pan. We have also known scalding to 170° or 175° Fahr. have the desired effect. A pint of boiling water is sometimes added to each gallon of milk in the pail; this is well covered with a cloth for half an hour, when the

milk is strained into the setting-pans. Pulping roots and mixing the pulp with chaff, and subsequently heating before feeding, clearly assists in the removal of turnipy flavours.

Adulteration of Milk is confined to the admixture of water or separated milk. Adulterations of these kinds are still too commonly practised, as our analysts' reports and the records of our police-courts abundantly testify. Under recent legislation all sales of food are presumed to be under the inspection of qualified officers; and of milk, as of other articles, analyses are continually being made when there is reason to suspect dishonesty, under which any abnormal poverty of milk is immediately detected. When the quality, either as regards the percentage of cream or of total solids, is found to fall beneath a certain very moderate standard, the seller is liable to a fine by the magistrate. Apart, however, from direct addition of water, a very general cause of the inferiority of milk no doubt exists in the quality of the food. When grains, roots, and inferior hay are the main foods given to the cows, the milk is often poor, altogether apart from adulteration.

The above reference to the inspector and public analyst reminds us of margarine and the artificial substitute for cheese, which certainly, however, are no part of English dairy husbandry, and cannot, indeed, be sold as dairy produce without a breach of the law, although it is constantly evaded. We do not propose to describe the processes by which the offal fat of the

Chicago stockyards is made up into a food resembling butter, for which it is, unfortunately, too often sold, and known as margarine; or by which milk, deprived of its cream, and re-enriched by the addition of questionable fatty matters, is made to produce an artificial cheese. These manufactured articles are, however, when cleanly made, perfectly wholesome foods; and margarine especially, which is now made in England, is also largely imported, and is being more and more consumed in this and other countries. The admixture of margarine with butter in certain proportions and under certain conditions enables unscrupulous traders to commit a fraud which is believed to be very extensively and successfully carried on, for the simple reason that there is no certain method of detection. Under present conditions the butter trade between the British farmer and the consumer is crippled, and this state of affairs is chiefly owing to the facility with which foreigners can place spurious manufactures upon our markets, and to the persistent manner in which the necessity for agricultural legislation is ignored.

CHAPTER V.

BUTTER.

Composition—Cream—Churning—Implements for the Butter Dairy.

The Composition of Butter varies somewhat with the method of its manufacture. If made from whole milk or from scalded cream, it contains more casein than when made from cream in the ordinary way. This is an important matter, not only as affecting its flavour, but also its keeping properties, for it is to the presence of casein that the tendency of butter to decay is chiefly owing. But the composition of butter also varies to some extent with the circumstances of its manufacture. It consists of a mixture of fatty acids in combination with glycerine, and it is largely on the feeding of the cows, and the temperature of the air, that the proportion of these several fats present in the butter, and its consequent firmness or softness, depend. The following is an analysis of a good sample:—

Ingredients, per cent.	Composition of Butter.
	Bell.
Pure Fats	90·27
Casein	1·15
Water	7·55
Ash	1·03

Good butter should not contain more than 10 per cent. of water and 0·7 per cent. of curd, but fault cannot be found if the former does not exceed 12 per cent. and the latter 1 per cent. As the keeping qualities of butter, together with its purity, depend almost entirely upon the presence of water and curd, advances have yet to be made even in the many dairy schools which are doing such good work in the country districts. The rancid flavour of bad or stale butter is believed to be owing to the decomposition of the glycerides of the fatty acids which is favoured by water, but checked for a time by salt or borax. The presence of bacteria, light, and air, all influence the changes in butter, but it is probable that the decomposition of the curdy matter present in butter is the first cause of the mischief which follows. The fatty acids are butyric, caproic, caprylic, and capric, known as the soluble fatty acids, inasmuch as they are to some extent soluble in water; and palmitic, stearic, oleic, and myristic, or insoluble fatty acids, as they are not soluble in hot water, although soluble in alcohol. Oleic acid forms by far the largest portion of the fat of butter, but it is to the group of soluble fatty acids to which we must look for the flavouring of good butter. These are present to the extent only of some 5 to 7 per cent., whereas in margarine they form little, if any, more than 1 per cent. of the whole. Butter is perfectly granular when it has been well made, and under the microscope presents a field of minute and quite distinct globules but little varying in size.

Cream, whether obtained by skimming milk after its ascension or extracted by centrifugal force, varies in accordance with the richness of the whole fluid and with

the manner in which it has been removed. Neither the quantity nor the quality of cream is a reliable guide to the quality of milk. When raised in cold water or cold air, its volume may be considerable and its quality poor; whereas cream raised from the same milk at a high temperature would be smaller in volume and much thicker and richer. Indeed, a thin poor cream may become thick if allowed to stand at from 60° Fahr. until lactic acid has sufficiently developed to cause it to coagulate. The common plan is to set milk in shallow vessels in a cool dairy at as near 60° Fahr. as possible until the cream has all risen. This plan is now becoming old-fashioned and it is not economical, inasmuch as it being impossible to regulate the temperature of an ordinary dairy, the milk becomes sour in hot weather before the cream has all risen, whereas in very cold weather the cream never all rises. The common practice in Normandy is to set the milk in deep conical vessels or "terrines" made of earthenware. The cold systems include the "Cooley," in which the milk is placed in deep cylindrical metal vessels provided with loose lids, which are plunged under water in a refrigerator-like box, the skim milk being subsequently drawn from under the cream, which, large in quantity but thin, is obtained in ten to twelve hours; the Swartz, which is chiefly adopted in Sweden and Norway, where deep, oval-shaped metal vessels without lids are filled with warm milk and placed in tanks of iced water , and the Jersey and allied systems, in which the milk is set warm in rectangular jacketed metal vessels, through which cold water is regularly flowing. These systems all have their merits. Some are not adapted to British dairies where ice cannot be provided,

or where the water contains too much heat in summer, whereas all are being gradually given up in favour of the separator, which must ultimately supersede every other medium now that a boy or girl can remove the cream from the milk of 50 cows at an average expense of one hour morning and evening, and without the necessity of a dairy at all. When, at the Danish power separator trials in 1883, we suggested the hand separator, the idea was looked upon as impossible. There are now at least twenty different makes in the market.

There is a general opinion that if a quart of cream makes a pound of butter the result is quite satisfactory; but it depends entirely upon the quantity of milk from which the cream was removed. The cream from the separator is usually taken thin for butter-making. If the cream is to be sold for consumption as cream, it is skimmed much thicker; indeed, it may have been again separated, in order to make it as thick as possible. The correct method of estimating the butter value of milk is to ascertain and regularly record the quantity of butter obtained from a given quantity of milk. The milk of a mixed herd, well fed, should yield 1 lb. of butter per 27 to 28 lbs. of milk on the average of the year; where the separator is used, and skilled hands employed, a high-class Jersey or Guernsey herd may yield 1 lb. of butter per 20 lbs. of milk, or even less. Under the old system, 35 lbs., and even 40 lbs., are often required. The leakages are usually found in the imperfect skimming of the milk, the want of ripeness of the cream, and careless churning. We have estimated that where all these mistakes are made the loss may be 25 per cent., representing a loss of 60 lbs. of butter in a large Short-

horn, or 1,200 lbs. in a herd of twenty similar animals per annum.

Under the old shallow system of setting, the milk is poured through a hair sieve or cloth strainer, for the removal of hair or dirt, into vessels, in which it stands some four inches deep; after standing for 12 hours in summer, or 24 hours in winter, it is skimmed with a thin and almost flat metal skimmer, perforated. It is skimmed a second time in the same way after another 12 hours, and often even a third and fourth time, so long as cream can be obtained. In specially-made creamers the milk is drawn off beneath through a plug, or through a syphon if the vessel be of glass or provided with a glass gauge.

Before the introduction of the separator the greatest quantity of milk in this country was set for cream in leaden cisterns about 4 inches deep, and brown earthenware pans white inside, some 21 inches across the top, 4 inches deep or thereabouts, and a foot or more wide at the bottom. Vessels of tinned iron of similar shape were also and still are commonly used for the purpose. Under ordinary management each day's skimming, or, rather, the cream separated at each operation, at whatever interval it be taken, is commonly placed in the cream-crock, a vessel which may be of earthenware or tin. Upon each addition to the store in this vessel, and, indeed, the oftener the better, the whole is mixed up together by means of a wooden stick kept for the purpose, the object being to promote uniform ripeness.

In Devonshire the milk is set for cream in metal pans of more than ordinary depth; and after from twelve to twenty-four hours, according to the season,

these are placed upon a furnace, and the contents scalded by heating up to 170° or 175° F., after which they stand till the milk is cool; then the cream is removed with a skimmer in the usual way. It is kept in the cream-crock until it is ready, when butter is easily made from it either by churning or "flapping" with the hand in a tub for about ten minutes or less. The latter plan, however, cannot be recommended; it is not only slovenly and imperfect, but uncleanly. The hand of the dairymaid should never come into contact with either cream or butter.

We now come to the separator, which has thoroughly revolutionised modern dairying. It has unfortunately proved a valuable aid to the makers of inferior produce, for it enables the cheesemaker and the condensed-milk manufacturer to remove a portion of the cream from the milk they handle with ease and rapidity. The separators in the market practically work upon one system: the milk passing through them is subjected to centrifugal force, hence the lighter portion—the cream—is separated from the heavier portion—the skim milk, as it used to be called. By more or less ingenious arrangements, the thickness of the cream can be regulated; in other words, more or less of the skim milk is permitted to pass off with it. There are hand-machines, which will separate 60 gallons, and power-machines, which will separate 350 gallons per hour, removing 97 to 98 per cent. of the butter fat present in the milk. These machines vary in speed, their drums revolving from 4,000 to 7,500 times per minute. The cream, extracted at a high temperature (usually 75° to 95° F.), is generally skimmed at the rate of 15 to 20

per cent. The separator adds rapidity to efficiency of workmanship, a truly economical arrangement, and, at the same time, it provides a perfectly fresh, sweet skim milk for household use. Dairy machinery is, however, still undergoing a process of evolution. A milking-machine has been invented and even used in daily farm practice (it is the joint patent of Messrs. Gray and Nicholson), while the separator has developed into a combined cream-extractor and butter-maker. Although both machines have to be simplified before the public will "take hold" of them, it is yet possible to produce butter direct from the cow, and this will probably be the *fin de siècle* climax, if we are not mistaken in the wonderful man whose intellect has almost encompassed the globe with separators which bear the name of Dr. de Laval. The best-known machines of other makers are the Danish of Burmeister and Wain, the Victoria of Watson and Laidlaw, the Alexandra, the Fesca, and the Lefeldt. In a butter dairy where the separator is used very few instructions are necessary. The cream is handled as in other cases, but the skim milk, if it is necessary to keep it sweet for sale in summer, may be heated up to 170° F. as it comes out of the machine, and then cooled down as low as possible by passing over a refrigerator.

In raising cream by the various setting methods, the milk should be carried to the dairy as warm as possible from the cows, and at once strained into the pans or creamers, which should be kept at as low a temperature as possible (above 40° F.), whether by the aid of cold air, ice, or water. When milk is subjected to a rapidly falling temperature, as, for

example, when it is set at 90° F. in a dairy or a cold creamer at 45° F., the cream rises with great rapidity. The reason is chiefly owing to the fact that fat, which forms the bulk of cream, has a lower specific gravity than the remainder of the milk. The difference in what we may call the normal specific gravity of the two materials is, however, widened under the conditions presented by a falling temperature; for the fat, not being so good a conductor of heat as the remainder of the milk, does not feel the change in the temperature so quickly, hence it rises more rapidly. Briefly, when subjected to a falling temperature, as suggested above, the fat of milk is lighter, as compared with the milk, than it is under other conditions.

When the shallow system of setting is adopted, the temperature of the dairy or setting-room should not be higher than 55° F., nor lower than 40° F. The choicest butters are made from the first cream skimmed, but excellent butter can be made even when the last possible cream is taken.

Ripened (acid) cream makes more butter than sweet cream; and if perfectly sweet cream is mixed with ripened cream and churned immediately, the whole of the butter will not be extracted. Sweet cream is not ripened by the mere fact of its being mixed with ripened cream; time must be allowed. The mixing of the cream of each skimming greatly facilitates the even ripening of the bulk. Cream should not be churned until twelve hours after the last skimming. It should always be kept in dry air, and, where churning is regular, at about 60° F. Twelve hours before churning,

the temperature of the cream should be gradually raised or decreased, as the case may be, with the object of bringing it to the temperature necessary for churning —56° to 58° in summer, to 62° or 64° F. in winter, varying with the temperature of the air. The cream should always be strained into the churn.

Churns are of various types. The necessary points are strength—as well of the metal fittings as of the wood; a mouth large enough for both hands to enter; the entire absence of *fixed* beaters or dashers. Churning, which should be more rapid in winter when the cream is apt to fall in temperature, and when churning is consequently prolonged, sometimes with bad results—should begin slowly, the speed gradually increasing. It is unnecessary to adopt a particular speed. Much depends upon the quantity of cream to be churned. The smaller the quantity, the more rapidly is the butter produced. The churn should, however, never be much more than half full. The longer the time occupied in churning up to a certain point, the higher the temperature rises, unless in very cold weather, when, the dairy being much colder than the cream, the latter is reduced if the process continues too long. The only danger of fast churning is over-churning and bringing the butter into a lump. Churning should cease immediately the butter granules have first formed, when a little cold water should be added. The churn may then be turned slowly until the butter has gathered into granules about the size of hemp-seed. It is then ready for washing. The butter-milk is first drawn off, cold water is then added, and the churn rocked several times, until finally the water last drawn off is quite

clear. Brine is then made—the salt being in solution—and poured on to the butter, where it may remain half an hour. When this is drawn off the butter is removed with a scoop, and worked on the table or butter-worker until the moisture has been removed as far as is possible. The butter may then be made up for sale or table. If, however, there are means, it should be cooled and hardened, when it will make up much better.

When butter is dry salted, the salt should be ground and dried, and sprinkled over the butter on the worker by the aid of a dredger, at the rate of half an ounce to the pound if mild salting is required, or three-quarters of an ounce if it is for keeping. No larger quantity of salt is necessary under any conditions.

A few other points may be noted. The churn should be ventilated two or three times during churning. The ear and the eye should watch for the butter coming, in order to select the right moment to stop. A change will be heard in the sound of the cream, and minute grains will appear on the glass, which will simultaneously become clear of cream. Hot water should never be poured into cream, nor should cream be suddenly cooled or heated more than 3° or 4° F. just before churning. The churn, the worker, and all the utensils are prepared for use by scrubbing with hot water, followed by cold, and, excepting the churn, by a rubbing with salt.

Among the implements required in addition to the churn are a butter-worker, rectangular in a small dairy, circular in a large one; a few strong pails, pairs of slicers, Scotch hands and butter scoops, cloth strainer,

scales and weights, a making-up board of seasoned wood, and a correct thermometer.

In potting butter for further use it is even more essential to remove every possible particle of curdy matter and moisture than under other conditions. The butter should be made in the cool of the early morning, or late at night if in summer or autumn. A glazed earthenware vessel should be used, and the inner surface covered with layers of butter as gradually as it is filled. The chief object is to keep out the air, so that by plenty of pressure no interstices are formed. When filled, a fine piece of muslin may be laid over the surface, and upon this a thick layer of salt, or the vessel may be filled up with thick brine.

Whole milk is sometimes churned. In this case the milk is kept at 60° to 65° until it has absolutely thickened or "lappered," when it yields a much larger percentage of butter than could possibly be obtained if it were churned sweet. The system, however, except where the sour butter-milk sells, is almost entirely a thing of the past.

CHAPTER VI.

CHEESE.

Composition—Curd—Various Cheeses: Gloucester, Cheshire, Dunlop, Cheddar, Derbyshire, Lancashire, Stilton—Utensils of the Cheese Dairy.

The Composition of Cheese depends, of course, upon the mode of its manufacture. The following analyses may be accepted as trustworthy; they represent average qualities of the several cheeses named, except in a few special cases.

ANALYSES OF CHEESE.

	Water.	Fat.	Casein, etc.	Sugar.	Ash.
Cheddar (Lloyd) under six months	35·88	30·94	29·26	—	3·92
English and American average	34·38	32·71	26·38	—	3·58
Cheshire (new) ...	36·96	29·34	24·08	5·17	4·45
Do. (old) ...	32·59	26·06	32·51	4·53	4·31
Stilton, average ...	30·35	35·39	28·85	—	3·82
Derby	31·68	35·20	24·50	4·38	4·24
Cream (1st prize Dairy Show)	33·5	58·3	8·2	—	—
Gorgonzola, average ...	44·04	29·84	28·06	—	3·87
Parmesan, average ...	31·34	19·22	41·99	—	6·25
Gruyère, average ...	34·87	28·91	25·87	—	3·84
Roquefort, average ...	31·20	33·16	27·63	—	6·01
Camembert (1st prize Dairy Show) ...	40·30	29·9	29·8	—	—
Edam, Dutch	36·28	30·26	24·06	—	4·90
Gouda, Dutch... ...	21·90	24·81	46·95	—	6·32

The quantity of fat present, to which the richness of the cheese is due, depends, first, on the quality of the milk; next, on the cream being all retained; and lastly, on the process of manufacture being conducted so carefully that no fat is allowed to escape with the whey.

Milk is converted into curd by the aid of rennet and heat. Rennet is a preparation, obtainable in liquid, powder, and tablet form, from the stomach of the sucking calf. Formerly it was customary for cheese-makers to prepare their own rennet, but the practice is rapidly dying out, most of the brands now manufactured being much superior as regards purity, strength, and evenness of quality—all very important considerations. The action of rennet is quicker the nearer the milk approximates to blood heat—indeed, assuming that it is never set above 95°, in British cheese-making at least, the length of time it occupies in producing curd is in an inverse ratio to the temperature at which the milk is set. Thus at a high temperature, such as 90° F., a much smaller quantity of rennet is necessary to convert a given quantity of milk into curd in a given time, than at a low temperature, such as 70° F. Again, the time occupied by the milk in coagulation is in an inverse ratio to the quantity of rennet used; for, if 20 cubic centimètres of rennet are required to produce curd from 20 gallons of milk at a given temperature in one hour, ten cubic centimètres only will be required to bring the curd under similar conditions in two hours.

In the production of curd, the maker has to remember that there are four conditions to be considered—the quantity of milk, the quality of the milk, the temperature at which it is set, and the time to be occupied in

bringing the curd. The temperature of the dairy has also to be considered, for the same milk will occupy a longer period in coagulation upon a cold day; and in this climate of ours we must prepare for considerable variations if our produce is to be of high quality. For this reason some makers raise the temperature of the milk one or two degrees when the temperature of the air falls. Milk should always be set in vessels which will retain the heat, and for small cheeses none are better than oak tubs with close-fitting lids. The rennet used should be carefully kept in a cold, dark cupboard, and the bottle well corked. Rennet which smells objectionably should never be used, even though it be new and "home-made," for bad rennet is the father of disease in cheese. In a cheese dairy makers run great risks where the cows are fed upon questionable foods; where they are not carefully cleaned, littered, and provided with clean quarters; where the milkers milk with dirty hands, and dip their fingers in the pails; where the milk is exposed in the cowhouse for any length of time, or where dirty pails, strainers, and utensils are used. An invisible germ may communicate disease to a huge hundred-pound cheddar, and destroy not only its value, but its maker's reputation.

The leading system of British cheese-making is that known as the *Cheddar* process, which produces a mild, mellow cheese of nutty flavour. There are several variations of this system, and under each cheese of fine quality is produced, not only in this country but in America and in New Zealand. In Somerset the round vat is used, but in Scotland and in America the rectangular vat is preferred, this being provided with a jacket by means of which the milk can be cooled or

heated. If the night's milk is cooled, very little cream rises; if it is not, a large quantity of cream will rise, and this must be removed and mixed with a still larger quantity of milk. This milk is then heated to such a degree as will suffice to bring the mixed evening's and morning's milk to the temperature at which it is decided to add the rennet. This temperature varies between 80° and 85° F., and similarly the time in which the curd is brought for cutting varies between 40 minutes and 60 minutes. Some makers add stale whey to the milk before the rennet is poured in, with the object of imparting to it a riper condition; others induce that ripeness by subsequently scalding to a higher temperature. If, however, the milk of the previous evening has been maintained as high as 70° F. during the night, it will usually be found ripe enough. When the curd is firm enough to cut, the knife is introduced, and it is divided with extreme care into very fine cubes. When the whey has risen and covered it, stirring commences with the breaker, this being continued from 35 minutes to 45 minutes, when the curd is left to settle at the bottom of the vat. Sometimes the mass is gradually heated by the introduction of steam or hot water in the jacketed vats while stirring proceeds; by this means the whey is easily expelled from the curd, which soon assumes the small, fine, even and shotty appearance so essential to success. In Somerset, scalding succeeds breaking down; a quantity of whey being removed from the vat is heated and returned to the mass, which is brought to a temperature of from 88° to 90° F. Stirring is then continued for from 15 to 20 minutes, when the curd is

again allowed to settle, and a second scalding takes place, the mass being heated with whey to from 90° to 94° F., or where one scald only is given, as high in some cases as 100° F. in the autumn, a season when the maximum temperature is required. The mass is now stirred again from 15 to 30 minutes, then left to settle, when the curd is tested, with the object of ascertaining whether sufficient acid has been developed. If the curd is acid enough, the whey is drawn off; the curd is then evenly piled, turned, cut twice, or even three times, into cubes of six to eight inches square, and kept warm between each operation. If the curd ripens slowly, longer time must be given between each cutting or turning. It must be mellow and distinctly acid before it is ready to grind, a condition which can hardly be described, but which can be perfectly demonstrated in practice. After grinding it is thoroughly mixed with fine dry salt at the rate of 2¼ per cent., and then packed into the cheese mould or vat and put to press. Pressing, during which the cloths are daily changed and the cheese turned, lasts three days; after which the cheese is trimmed, bandaged, and taken to the ripening-room, which should be maintained at from 64° to 70° F., the room for advanced cheese being five degrees lower. It was formerly assumed that Cheddar cheese could only be made in a certain favoured district, but the idea has long been exploded, and no educated cheese-maker now entertains it for a moment. As a matter of fact, there is no variety of cheese manufactured in a temperate climate which cannot be made wherever good milk can be produced and a suitable dairy provided.

With the exception of a few of the most perfectly-constructed dairies in the south-west of Scotland, no cheese dairies in Great Britain, nor, indeed, in Europe—this we can say with safety—approach in completeness those which are found on the best estates in Cheshire, the county in which *Cheshire cheese* is the chief product of the soil. In many respects the system of manufacture of Cheshire is identical with that adapted in making Cheddar cheese. The evening's milk is cooled down to 70° F. in the American vat, and on the following morning the cream is skimmed off, mixed with milk, and returned. The morning's milk is added, and the whole heated to from 84° to 90° F., according to the practice of the dairy. The colouring matter, annatto, where coloured cheese is made, is then added, and well stirred in when the milk is ready for the rennet. Stirring is continued from fifteen to twenty minutes, after which the vat is covered up until the curd has set and is ready to cut. After cutting—horizontal and vertical multiple bladed knives being used—heat is turned on and breaking down is commenced and continued until the curd is fine and firm. It is then allowed to settle, and is subsequently collected at one end of the vat, the whey being drawn off at the other end, passing through two strainers to prevent the loss of curd. A rack is placed at the bottom of the vat; this being covered with a cloth, the curd is piled upon it to facilitate drainage, then it is cut into cubes, turned, cut again, subsequently broken up by hand, piled, cut, and turned again until its condition fits it for the mill, when it is ground, salted, $2\frac{1}{2}$ per cent. of fine salt being used, and put, while still warm, into the

mould. It is next placed in a small heated chamber, known as the cheese oven, after which it goes to press, remaining from three to six days, being turned, and the cloth changed daily. Its final destination is the ripening-room, usually an upstairs apartment, where it is systematically turned, trimmed, and bandaged, where bandages are used. Like Cheddar, Cheshire cheeses are of considerable size, and made of whole milk, the removal of any portion of the cream seriously affecting the quality of the cheese. It is not possible, however carefully the work is performed, to prevent a small percentage of the fat of the milk running off in the whey. This fat is not lost; it rises in the whey tank, is skimmed off, and made into butter, so that where the herd of cows is large the sale of whey butter is considerable. It is probable that, although the separator might be the means of improving the butter, the whey being passed through it while fresh, the extra labour entailed would result in pecuniary loss. The next best plan—and this entails no extra cost—is to heat the whey to 95° or even 100° F., and to allow it to cool quickly, and to as near 50° F. as possible; 40° F. would be better, but this would not be practicable. By this means the cream rises rapidly, and may be removed before any change seriously affecting its flavour has taken place.

In making cheese of this character, the great object is to retain the fat, to cut fine, and to grind and salt when the right moment has arrived, *i.e.*, when sufficient acidity has been developed; for upon this depends the mellowness and flavour of the cheese. As acidity is the result of the activity of microscopic organisms known as bacteria, it follows that should the milk or the

rennet be impure, the utensils, the dairy, or the hands of the maker dirty, organisms foreign to pure milk may be introduced and the cheese spoiled.

The manufacture of Gloucester and Derby cheese cannot be said to be either very distinct processes, or processes which ought to be encouraged. Both makes are languishing; indeed, some makers do not hesitate to exhibit cheese made upon the Cheddar system, but in different moulds, as Gloucester or Derby. We have frequently listened to the recitals of the glorious days that are past, when cheese in these two counties was a specialité—a thing to be remembered. Happily, the speakers possessed no means of inviting comparison with the cheese of to-day. Certain it is that, however favourably they might at one time have compared with other British makes, they can compare no longer; and it is equally certain that Cheddar and Cheshire have never been so skilfully made and so good as they are now. No other varieties but Cheddar, Cheshire, and Stilton, not even the Leicester cheese, are recognised at our dairy schools, and it is questionable whether a single application has ever been made for instruction in any but these and the soft cheeses.

The Accommodation needed for Cheese-making varies in different districts. Everywhere, however, the same instructions as to cleanliness are of course imperative. In Gloucestershire, a room on the north side of the farmhouse serves for holding the milk, whether set in pans on shelves for cream, or in the cheese-tub on the floor for curd. Here, too, are the leaden cisterns in which the whey stands, a foot deep, for cream, and

from which, after skimming, it drains away to the pig's vault. On the north side of this room is a paved shed in which churning is done, and in which vessels are placed to dry; and at one end of this shed is a wash-house (with the well close by), with furnace and boiler, in which milk may be warmed, and where the vessels are washed. In addition to this, there is a cheese-room, generally a loft over the dairy; but for hot summer weather a detached and cool airy place is to be preferred. Here, on the wooden floor and on wooden shelves, the cheeses are placed and turned repeatedly, until ripe for sale.

Stilton Cheese is peculiar to Leicestershire, although it can be successfully made wherever good milk can be produced—where the peculiar temperature and humidity it requires can be obtained, and where the maker is possessed of the required skill. Before attempting the manufacture of this cheese upon an important scale, the maker should thoroughly master the principles involved, as nothing is easier than to produce an article which, when the season for sale arrives, is practically worthless.

The milk, fresh from the cow and well strained, may be set for curd at from 82° to 90° F. Which temperature suits the milk the best will have to be ascertained in practice; a record should, therefore, be kept for reference when the cheeses are ripe. The patent rennet will be found superior to that made at home. When the curd is fit for cutting, it may be removed, slice by slice—a cream skimmer will do very well for the purpose—into a cheesc cloth spread out to receive it.

The draining-table on which this cloth is laid should be of cement or metal slightly inclined to the front. The four edges of the table should be provided with a rim, and in the front there should be a hole through which the whey can escape. It therefore resembles a sink, the outsides of the cloth lying over the edges, and thus the curd is kept together. When the curd has become partially solid the four corners of the cloth are tied together to further express the whey, and this practice is continued until the curd is removed altogether, broken up, and laid in the cooler to air. Here it is left awaiting the curd produced from the milk of the next meal, which is treated exactly the same. On the afternoon of the second day the two curds are broken up fine, salted—2 per cent. of salt being used—and the moulds filled. These operations must be conducted in a dairy in which the temperature is controlled between 56° and 60° F. The young cheese must not, however, remain here, but be removed to an apartment in which the temperature is at least five degrees higher, in order that it may properly drain. Inattention at this point will assuredly spoil the cheese past recovery. It is now turned daily until it appears firm enough to stand alone and to maintain its shape, when the mould is removed. The cheese is then enveloped in a clean calico bandage, neatly and evenly pinned, and carried to a separate shelf. It receives a fresh bandage every day until the coat commences to form, when it is removed to the drying-room, an apartment kept at as near 55° F. as possible, the air being dry. Here it is turned daily until the coat is complete, when it goes to a moist apartment, five degrees warmer,

to ripen. Stilton cheese does not realise the prices of olden times; competition is keener, and dealers know it. It is questionable whether, remembering this fact, and the further fact that Stilton loses considerably in weight by the time it is ripe for the table, it pays the general maker better than first-rate Cheddar.

Truckles and Wiltshire loaves are merely forms of Cheddar; indeed, makers have learned that to make upon any other system is to fail to obtain the best prices. When fine cheese is made in loaf form it invariably sells well, as families are accustomed to go direct to the maker, to whom they pay a better price than he obtains wholesale.

Leicester cheese is a specialité, and worthy of some remark, although connoisseurs say that it is not what it used to be. The writer has had excellent opportunities of testing samples when acting as a judge at the Leicestershire shows, and he is bound to say that the inferior specimens far outweigh those which possess merit. In the manufacture of Leicester cheese patent rennet is the best, but home-made rennet is still used, about a pint per 80 gallons of milk. The milk is brought to a temperature of from 76° to 78° F. in summer, but during the cooler weather of the early and late seasons 80°, and even 82°, is adopted. The curd is not fit to cut for about 1½ hours, and when well broken down the whey is drawn off. When the curd is firm enough and has developed sufficient acid, it is placed in a dry cloth, very slightly salted, put into the mould, and then sent to press for 24 hours. It is salted on the outside for four or five days, and having finally been well washed

with warm whey it is taken to the drying-room, where it remains until ripe for sale.

Wensleydale Cheese deserves some notice here, for when perfect it is one of the best varieties of cheese produced in these islands. Mellow in the extreme, rich, finely flavoured and blue moulded, it is scarcely excelled by Stilton, however well this popular cheese may be made. There has hitherto been an entire want of system among the makers of the beautiful Yorkshire dale, but since the writer had an opportunity of seeing the practice followed, and calling attention to the subject, action has been taken in the right direction. Mr. John Benson, the able expert and manager of the Dairy Institute of the British Dairy Farmers' Association, has been engaged to make an investigation and to recommend a system. This he has done, and it is therefore probable that the 1892 make will be of a uniformly high quality.

Soft Cheese.—A few years ago the soft cheese made in England was extremely limited in quantity, whereas the quality, except in a few instances, was of a more than doubtful character. Since the opening of the Institute mentioned above, however, a large number of persons, including many dairy teachers, have been instructed in the manufacture of several varieties of soft cheese, which are produced upon a rational and definite system—a system which the writer was enabled to introduce—and through this means soft cheese-making is now being taught in almost all

parts of England. We describe three of these systems briefly.

Brie (English type).—Two tin hoops are required—one plain, 2 in. deep by 10 in. in diameter; the other of similar size, but provided with a rim into which the first-named fits. Add to this two half-inch boards, 12 in. square (beech is to be preferred), and a pair of straw mats, also 12 in. square, and the plant for making one cheese is ready. The milk is set at 82° F. (10 to 12 lbs. will be necessary), the quantity depending upon the quality of the milk. The curd is brought in four hours, taken up in thin slices, and deposited in the mould formed by the two hoops fixed together, and laid upon the mat and board. Here it remains until the top hoop can be removed, when a clean mat, followed by a clean board, is laid over the top of the cheese, which is then inverted, the dirty mat and board being removed and cleaned for the next turning on the following morning. When the cheese is quite firm, so that the remaining hoop can be removed, it is salted with very fine dry salt, over the surface and sides (one side at each of two turnings), and then left until a very delicate white mould appears upon the coat. It must, however, be turned each day, and kept at a temperature of about 60° F. It is then ready for the table.

The Coulommiers (English type).—This variety is of smaller size, the same quantity of milk (10 to 12 lbs.) making two cheeses. The moulds are 2 in. deep by 5 in. in diameter, and the mats and boards 13 in. long by 7 in.

wide. The rennet is added at 78° F., and the curd brought in eight hours. The after-treatment is the same as that adopted for Brie.

Mignon or Gervais.—This cheese is made of a mixture of cream and milk, set at a temperature of 65° F. Six drops of rennet (Hansens as a standard) are sufficient for 2½ quarts of rich milk and 1 quart of cream, equal to the production of one dozen cheeses. The curd is fit to cut in from six to eight hours, when it is removed into a cloth, in which it is allowed to drain until it is sufficiently solid and consistent to press. Removed into a clean cloth, it is laid within a wooden frame with open sides, and pressed with a close-fitting follower of wood, heavy enough to cause the whey to drain away without any loss of cream. This pressure, with one or two manipulations, with the object of maintaining evenness of consistence, continues until the curd is as thick as an ice cream, when it is pressed into the specially-made moulds lined with prepared paper, both of which are now easily obtainable. This cheese is not eaten until two or three days after manufacture. The quantity of cream added may be varied.

An excellent **Skimmed Milk Cheese** may be made upon the system suggested for the Coulommiers, with this exception, that the temperature of setting for curd should be reduced to 76° F., the curd being cut in nine to ten hours.

Pure Cream Cheese is very easily made. Pure cream, to which two drops of rennet per quart are

added, is poured into a damp cheese-cloth, and hung in a dry dairy at 62° F. to drain. When solid and consistent it is placed in muslin in a perforated metal mould—round, square, heart, diamond, or fleur-de-lis shaped—covered with a follower, and pressed with a small weight until it is quite firm. A few days usually elapse before it is at its best.

Sage Cheese should be kept twelve months before it is fit for use. Bruise a quantity of sage in a mortar, also a little spinach for the sake of the juice, which will give a green colour, the sage alone not being bright enough in itself; these juices, squeezed together through a cloth and added to about a pailful of milk with a proper proportion of rennet, will make enough sage curd for one thick cheese. When the whey is drawn from this in the usual manner, the curd will be found of a much deeper colour than might be expected from the pale green given to the milk. This sage curd should be kept quite separate from the bulk. When ready for the vats, having been crumbled into small particles separately, some of the green curd should be mixed with the other (about one-third is sufficient), either by laying it in rows or mixing it together in the vat; care should be taken that none of the whey drawn from it gets into that intended for butter, or it will give it the flavour of the sage. The after-management of this cheese is the same as that of other thick cheeses.

Utensils for the Cheese Dairy.—Besides the ordinary milking pails, and sieve through which the milk is poured from them, a deep cheese-tub, to stand on the

floor of the dairy, in which the curd is set, is required, holding three gallons, or thereabouts, for every cow in the dairy. Tubs or vats upon wheels are especially convenient, as they can be removed from one apartment to another. When the milk or the curd requires a change of temperature, this plan is often of great value. A "ladder" is needed to rest across this tub for carrying the sieve through which the milk is poured. Curd breakers, curd knives, strainers, and scoops are required. A curd mill, costing from 20*s*. upwards, being simply a hopper, at the bottom of which is a galvanised cylinder studded with short radial arms revolving between corresponding pins fixed in the sides of the trough, and passing the curd placed in the hopper in a crumbled state, is also needed. Slate vats or tanks of sufficient capacity to hold the whey, where it is set for cream, are necessary. Cheese-vats or moulds, in which the curd is pressed into the form of the future cheese; and cheese-presses, either direct masses of stone lifted by winch and rope and pulley, or lever presses, are needed. The heaviest of the former consists of a block of stone of nearly three feet cube, and weighing 20 to 30 cwt. The latter are of various forms, and produce, by the action of a small weight, whatever pressure is desired. They cost about 50*s*.; or, if two together in one frame, about 5*l*., and may be used to exert a pressure varying from 1 cwt. up to 30 cwt., or even more. We may also name here, as a recent invention with probably a future, a series of cheese-shelves arranged in book-case form, *i.e.*, closed on one side, and slung on two pivots, enabling it to be swung round, bottom upwards, so that the top

of each shelf containing cheese becomes, in its turn, the floor on which those cheeses rest; and the whole work of turning a number of cheeses is done at once. For soft cheese-making a great variety of small utensils are required, including oak tubs with lids, curd spoons, moulds of tinned iron, mats, boards, rennet measuring tubes, a salt box, and dredger.

Insects affecting Cheese.—Cheeses are liable to the attacks of various insects, the principal of which are the cheese-mite and the cheese-fly, *Piophila casei*, whose maggots are the well-known jumper. The cheese-fly, we may add, is a little greenish-black fly, with yellowish head and legs. In order to escape its attacks, the cheeses should be pressed dry, and so made as not to crack; they should also be repeatedly wiped with a flannel cloth, and turned on boards kept clean by scrubbing and occasional rubbing with fresh oil.

CHAPTER VII.

GENERAL MANAGEMENT.

Dairying and Grazing—Profitable Use of Milk—Cropping of a Dairy Farm.

Dairying or Grazing.—An occupier of grass land has the choice of several methods of turning it into account. If it is of good quality he may devote it wholly to the production of beef; if it is poor, and some arable land is attached, it may be wholly devoted to the rearing of young stock, every cow bringing up several calves. Under ordinary circumstances he may make either butter or cheese; he may sell milk, or it may be more profitable to use the milk in making veal. The nature of the market for his produce will probably determine his choice. It is no part of our plan to discuss the relative merits of grazing and dairying here, but there is one point of the comparison which ought to be alluded to, and that is the greater draught made upon the resources of the land by any system which involves the annual sale of the milk, either whole or manufactured into cheese.

Milk removes some of those constituents of soils on which their fertility practically depends. As the sole food of the young, it builds up their bone as well as their flesh, and among its ash constituents, therefore, are to be found the mineral constituents of bones; whereas in the casein, of primary importance in the production of the muscular or fibrous tissue, nitrogen, the most costly of all the fertilising property of soils, is

the most important element. One thousand parts of milk contain about 7 parts of ash or mineral matter; and this chiefly consists of phosphate of lime and potash, which include the three most important mineral plant foods. The following figures are taken from leading English and German authorities.

Among the mineral ingredients of 1,000 lbs. of milk, (about 100 gallons) are :—

	Wolff.	Warington.
Phosphoric acid	1·73 lbs.	2·00 lbs.
Magnesia	0·18 „	0·20 „
Potash	1·50 „	1·70 „
Lime	1·33 „	1·70 „
	4·74 „	5·60 „

If a cow yields 600 gallons of milk a year, whether this be sold, or converted into cheese for sale, or set for cream and made into butter and skim-milk cheese, these products being sold off the farm, a considerable quantity of mineral matter is removed from its soil.

Taking Mr. Warington's figures as our standard, the loss of phosphoric acid per 600 gallon cow would be 12 lbs. and of potash 10 lbs. The phosphoric acid in the cheapest form of phosphatic artifical manure, basic slag, is 17·3 per cent., whereas the potash in kainite is 13·8 per cent. Further, one ton of good mixed dung contains about 8 lbs. of phosphoric acid and 12 lbs. of potash. We have also to consider that the nitrogen in 1,000 lbs. of milk is about 5·9 lbs., so that the quantity of dung it would be necessary to purchase to replace the nitrogen removed in 600 gallons of milk would be three tons, the average quantity of nitrogen per ton being about 12 lbs. Where dairy farmers

are accustomed to use purchased cotton or linseed cake, bean meal, bran, or malt combs in economical quantities, no loss of fertilising matter occurs, and this plan has the advantage that it serves a double purpose. Where, however, milk selling or cheese-making is continued for a long series of years without the introduction of purchased foods or manures, it undoubtedly tells upon the fertility of the soil, and is a loss to which rich grazing grounds, where full-grown animals are brought simply to be fattened, are not subject. In illustration of the perpetual drain of phosphates which the cheese manufacture entails upon the soil, it may be mentioned here that the dairy pastures of Cheshire have been wonderfully improved by the addition of bone-dust as a top-dressing to the land, a manure which supplies just those ingredients of which the cheese had deprived it. The loss entailed by cheese-making is not so great as where milk is sold, and on a butter-making farm it is still less, unless the skim-milk is sold.

The Most Profitable Use of Milk.—This necessarily depends altogether on the market. (1) To sell the whole milk direct to the consumer is often the most profitable method. One penny a pint is a common average wholesale price to the cowkeeper, from which he must deduct the cost of churns and conveyance. His cows may yield under liberal treatment from 600 to 700 gallons annually, and thus return (gross) from 20*l.* to 23*l.* annually a-piece, but an average of £20 is seldom exceeded. (2) To make milk into butter and skim-milk cheese, may, with a yield of 600 gallons annually, and calculating 20 pints per lb. of butter

and 1½ gallon per lb. of skim-milk cheese, yield as follows:—

	£	s.	d.
600 gallons of milk = 240 lbs. of butter, at 1s. 1d.	13	0	0
500 gallons of skim-milk = 330 lbs. of cheese, at 3d. per lb.	4	2	6
Value of whey and butter-milk	1	0	0
Total annual yield per cow ...	£18	2	6

(3) To make milk wholly into cheese may, with a yield of 600 gallons of milk, result in 5 cwt. of cheese per annum—a very unusual produce, however; and this at 60s. per cwt., a moderate price, results in an annual produce of £15 per cow, to which must be added, perhaps, 50s. worth of butter and bacon, or £17 10s. in all. The more common produce, however, upon the best farms is:—

	£	s.	
4 cwt. at 62s.	12	8	
Whey butter	2	0	
Whey	1	0	
100 gallons of milk sold at 9d.	3	15	
Or in all	£19	3	per cow.

(4) To use the milk wholly for fatting veal, at the rate of 10, 16, 20, 24, 27, 30, and 32 gallons in seven successive weeks, using 160 gallons or thereabouts in that time for producing about 1 cwt. of veal, will enable each cow thus to fatten 4 cwt. or more of veal per annum; and this, at the price of £4 per cwt., would yield £16 annually per cow. From this, however, must be deducted the cost of such other foods as the calves consume, and also a certain sum at which the risk attending the management of young stock must be valued—a risk which in skilled hands does not accompany the other methods

of turning milk into money, at all events to anything like the same extent. It must, however, be remembered that a pecuniary value attaches to the manure of calves so fed, which it is fair to add to the receipts.

It may thus be assumed, after making sundry deductions, that £20, £18, £17 10s., and perhaps £16 may be taken as the produce of well-managed, deep-milking cows, in milk, butter, cheese, and veal respectively; the value of the calf, less the milk it has consumed, 30s. or 35s., when a week or ten days old, has to be added. It will, however, be generally felt that these figures stand too high for ordinary experience; and certainly that which is true of well-managed individual herds is not necessarily true of all, however perfect the management may be. In illustration of this, two facts may be mentioned, one of which entirely corroborates our estimate; but the other, the more trustworthy of the two, considerably discounts it:—(1) The dairy statistics of 15 farms in Gloucestershire prove that in the year of their collection, 439 cows produced 1,604 cwt. of cheese, 5,268 lbs. of milk-butter, 11,420 lbs. of whey-butter, besides a sale of 354 calves and 1,756 score lbs. of bacon. The total sales at present prices would probably stand thus:—

	£	s.	d.
1,604 cwt. of cheese, at 60s.	4,812	0	0
5,268 lbs. of butter, at 1s. 1d.	285	7	0
11,420 lbs. of whey-butter, at 10d	475	16	8
354 calves, at 30s.	531	0	0
1,756 scores of bacon, at 11s. 6d.	1,009	14	0
439 cows produced	£7,113	17	8

This was equal to nearly £16 4s. per cow, corresponding

very nearly to the figures suggested as the probable money produce of cheese-making. (2) The other fact is that in many other large dairy districts it is common for the farmers to let their cows for the year to the dairyman, agreeing to set apart particular pastures for them, and to give them certain quantities of fodder and of green and other food. The hirer of the cows has the use of all the accommodation which the farmery affords, the use of dairy utensils, etc., and he undertakes the entire management of the animals, and of their produce, which belongs to him while they remain in his hands. And the fact to which we allude is, that the farmer is willing to let his cows to the "bower," as he is called in Wigtonshire, for from £10 to £12 a piece; which, if their average produce realises £14 or £15, seems to leave a small enough margin for the labour and profit of the dairyman who hires them.

The Cropping of a Dairy Farm has already been considered. We refer to it again under this section to insist on the great advantage to large dairy farms of a considerable portion of the land being arable. The ability to maintain cows during the winter season—when dry, or not yielding milk enough for the maintenance of the general dairy management—on roots and straw, instead of hay, and thus to set apart a larger portion of the grass for summer pasture to its own great advantage, and to the greater productiveness of the cows at their most productive period, cannot be overrated, while the same foods, with a little hay and a liberal allowance of cake or meal, will enable the farmer to maintain a full winter

dairy. If every 100 acres of grass land, being at the rate of more than 1½ acres per cow of whole summer pasture, together with the aftermath of a corresponding quantity needed for winter hay, will maintain a herd of 30 dairy cows, then any source of winter feeding which will displace two-thirds of the hay required will set free for pasturage two-thirds of the extent of grass-land to be mown. It is not too much to say that by 30 acres under arable culture as much winter food will be provided as by 50 acres of grass-land mown. Supposing, then, these 100 acres to be divided into 80 acres pasture and 20 acres arable, it is plain that of the half of this pasture (40 acres), which ordinarily would fall to be mown, at least two-thirds (26 acres) would be set free by the winter food (straw and green crops) yielded by the 20 acres arable; and the stock capable of being kept on the remaining 80 acres pasture, as compared with that on the 100 acres of whole pasture, depends on the relative summer produce of 66 acres whole grass and 14 acres aftermath, as compared with that of 50 acres whole pasture and 50 acres aftermath. There cannot be a doubt that the former will yield more food than the latter, and at the most productive time of the year, while the land will at the same time, under this plan, be more likely to increase from year to year in value. It thus appears that a larger dairy stock can be kept upon a farm so managed, while, at the same time, one-half of the arable land will be yielding its valuable produce of grain for sale. It is, however, also certain that the use of home-grown beans, peas, and ground oatmeal is economical and desirable while the prices are so low as

they have been in 1890, and that where pulse cannot be grown for the purpose, the use of decorticated cotton cake, bran, and malt-dust should be adopted, not only on account of their great value in milk-production, but because of their importance in the improvement of the manure.

Let us add that the selection and maintenance of the herd—gentle, regular, and punctual treatment of the animals throughout the year; provision of sufficient wholesome food for them, and abundant water, with frequent change of pasturage when in milk—*these* are the special maxims of successful dairying. If on the one side we have the proper cultivation and management of the land, and on the other cleanly, careful, and skilful management in the dairy, then a maximum of dairy produce may be expected. But this depends essentially on the health, and therefore on the treatment, of the animals which yield it. If one remark more be permitted, it should contain the answer of an old dairy farmer when asked as to the secret of his success. He had, he said, always seen for himself that his cows were thoroughly milked out.

CHAPTER VIII.

FOREIGN DAIRYING.

SCANDINAVIA.—FRANCE: French Cheeses, Brie, Coulommiers, Géromé, Journiac, Livarot, Mont d'Or, Neufchâtel, Mignot, Pont l'Evêque, St. Marcellin, St. Remy.—GERMANY: Limburg and Backstein Cheeses.—HOLLAND: Edam and Gouda Cheese, Delft Butter.—ITALY: Gorgonzola, Parmesan, Ricotta Cheeses.—SWITZERLAND: Emmerthaler, Gruyère, Vacherin, Schabzieger.

DENMARK.

IT is not necessary to enter fully into the system of dairying in Denmark, as far greater space would be required than the limits of this work permit. It may be remarked, however, that the Danish industry, though but of comparatively recent creation, has been conducted so energetically that it has become, if we consider the size of the country, the most prominent of any in Europe. It is true, however, that cheese-making is here still in its infancy, and that there is practically no cheese which is essentially Danish, which is recognised even in Denmark.

The butter of Denmark is now so famous in this country that it not only obtains a higher price than the best Irish, but it sometimes beats the best samples of salted butters from France; and this the French authorities themselves admit with regret. At the present moment the centrifugal separator is doing

immense work in Denmark, where the system is as follows:—The cows are milked very early in the morning, and the milk is immediately passed through the separator; but the cream is not churned on the same day. It is, however, placed in vats where a small quantity of sour butter-milk is added, in order that it may be sufficiently ripe for churning on the following morning, it having been proved beyond doubt that butter made from sour cream not only keeps better, but is produced in larger quantities. The barrel and Holstein churns are in general use, and churning is continued until the butter comes in small grains, when the butter-milk is run off, and the butter carefully removed from the churn. Where the butter-worker is not used—though this, like the separator, is now becoming popular—the butter is worked and made up by hand, either upon a small table or in a wooden trough. Here the dairymaid thoroughly manipulates it, and as each piece is kneaded it is laid aside and salt strewn upon the top. When all the butter has been worked, and the pile is complete, it is cut down in slices, and these are again kneaded with the hand, in order to thoroughly amalgamate the salt with the butter. In hot weather it is laid in hardening boxes upon which ice is placed (between the first and second working), but be it observed it is not washed as in England, the hand of the worker alone being used to extract the butter-milk. When salted and firm, it is quickly packed in kegs and sent to the exporter.

A great deal of attention is paid by the Danish Government to the proper instruction of young people destined for agriculture; and the majority of the best

dairy farmers who are sufficiently interested are provided with pupils sent by the Professor of Dairying. These remain at the farm from twelve to eighteen months, paying a small fee for the instruction they receive. They feed and milk the cows, assist on the farm, and are taught in the most complete manner the whole routine of dairy work. Each pupil is supplied with a small book, in which is a slip for each day, and upon this he enters the returns of the cows under his charge, often endeavouring to show a better weekly return than his fellows. These figures are checked by the head dairymaid, who also keeps a book showing the quantity of milk obtained and cream and butter yielded, with minor details which are very necessary in a large dairy. The cream separator is now generally used, but the Swartz plant, once generally adopted, is utilised for cooling cream or skim-milk as may be required. This consists of a vat some 9 ft. by $2\frac{1}{2}$ to 3 ft. and some 2 ft. in depth, which is built of concrete or brick lined with cement. At one end is a tap for the supply of water, and at the other an outlet pipe to carry surplus water away. This vat is usually built in the milk-room on the coldest side of the house, and is in summer daily provided with ice, which is allowed to float in the water. The Swartz cans are oval in shape, 24 inches deep, by about 8 inches wide and 16 inches long. When used for creaming, the milk remains in these cans from ten to twelve hours, when the cream has all risen and is skimmed off. The skim-milk is then taken away, either for manufacture into cheese, or for the house and the cattle, and the next milking is poured in. This system is ex-

tremely simple, but cannot be properly conducted at a higher temperature than 45° F. If, therefore, a cold spring of water can be obtained which will not rise higher than this, ice will not be required, but in reality an exceptionally cool milk-room is required in addition to the water. Ice is generally preserved in Denmark, either in barns or square yards, with four brick walls, and if well buried in sawdust and examined weekly, so that crevices may be filled up by treading the sawdust in, little difficulty is found in keeping it until the end of the summer, and frequently, indeed, until a second summer.

In Sweden and Norway the system of butter-making is practically the same as in Denmark, and at the present time it is the aim of both Swedes and Norwegians to carry out the Danish system in its entirety, and to obtain Danish prices. The use of the cream separator is now being largely extended in these countries, and every improved appliance is being gradually adopted. The only cheeses worthy of the name which are made in Scandinavia, and which are peculiar to it, are the "Myseost," which is made from whey, and largely composed of the sugar of milk, and a skim-milk cheese, flavoured with cummin or carraway seed, which is by no means unworthy of notice. The manufacture of Cheddar and Gruyère is now being taught at the Government Dairy Schools, but the results we have seen at the well-equipped schools we have visited leave much to be desired. The colour of the Myseost is generally green, but, although sweet, its flavour is by no means agreeable, and a taste for it has to be acquired before it can be enjoyed. The whey is boiled upon the

fire until almost three parts have evaporated, it being continually stirred the while. During the process the top or cream of the whey which had previously been skimmed off is added, and when a scum or foam appears upon the surface this process ceases. As may be supposed, after so much evaporation of water the residuum has become a sticky paste, which, as we saw at Hanna Neilsen's, was poured into a mortar, and there beaten with a pestle by seven or eight pupil dairymaids in turn, until it was ready to place in the mould, where it remained under pressure for about two or three days, when it was sold to be eaten fresh. This cheese can be improved by the addition of new milk or cream during the process of heating. The cummin-seed cheese is as a rule very badly made, but were the Swedes as expert as English cheese makers they would long since have made it a leading article of their produce. The dairying capacity of both Norway and Sweden is considerable, but by no means so great as is popularly supposed. The traveller is impressed with the vast areas which are covered by woods, lakes, and stone. We have seen excellent farms in both countries, but the best farmers find it necessary to import British cattle. The cultivation of arable crops for milk production is very small, grass in summer and hay in winter being the chief foods, the latter being largely secured by the laborious method of drying upon poles or wires; the cowhouses are substantial and often cleverly constructed, the finest houses we have seen in Europe being those of the Stockholm Dairy Company near Mölnby, over which we were shown by the very able but blind manager. There is much to be

desired in some of the country dairy factories, in most of which export butter is made, and in some skim-milk cheese of very inferior quality. The people of all these countries deserve great praise for the excellent work they are doing, considering how small is their number, the poverty of the material, and the modesty of the means at their command. In the past it has been the practice to contrast them with Great Britain and unfavourably to our own country, but no one properly acquainted with British dairying could make such a mistake. It is not a matter of superiority of skill that Danish butter sells so freely in the British market—it is a question of economics, for we venture to say that there is no branch of dairy work in which we can be approached by our energetic and amiable neighbours.

France.

Although the dairy is part and parcel of the system of agriculture in almost every part of France, it is hardly necessary, perhaps, to say that it is much more extensive, and far more perfect in its arrangements in the northern than in the southern departments, where the culture of the grape is more suitable to the climate and congenial to the people. It is true that the cultivation of dairy cattle and the manufacture of the famous cheeses peculiar to France is conducted in many districts in the centre and west of the country; but there are no farmers who can approach those of Calvados and La Manche, whether it be in the manufacture of cheese and butter, the system of cropping for dairy purposes, or the production of the highest quality of

dairy cattle. This being the case, the general remarks which follow have particular reference to those departments, which may be taken as an example of the highest class of dairy farming in France.

The cows generally preferred are those known as the Cotentin, large fleshy cattle of fine quality, and magnificent milkers. These animals, together with the luxuriant pasture of these departments of Normandy, have much to do with the system which has been adopted and raised to such a pitch of celebrity. While it is the custom to house the cattle in winter, and to feed them upon hay—which is seldom built in ricks, but placed in the barn in small bundles of about 10 lbs. each—with mangels, turnips, and even carrots and cake, the farmers have a great idea of summer pasturing ; and to such an extent is this conducted, that we have seen herds of cattle turned into meadows with two feet of grass, almost ready for the scythe, into clover, vetches, and lucerne, where they were tethered as in Jersey, and into which the dairymaids went three times a day for the purpose of milking. This is, indeed, a common custom; and in large dairies, with the aid of the deep brass *cannes*, holding from four to six gallons, which are carried upon the head of the girl, or placed in panniers, two upon either side of the back of a donkey, the milk is all obtained without the necessity of driving the cattle home. The dairymaid, like the labourer, is a hard-working and invaluable servant, whom it would be difficult to surpass in this country. When the milk is taken to the farm, it is first strained, and then poured into earthenware pans, which somewhat resemble in shape the galvanised iron pail used in this country,

although they are deeper and smaller in diameter at the bottom. Sometimes, however, these pans are almost oval in shape, with a handle on either side, so that the system of setting the milk is quite different from that usually adopted, and is a deep instead of a shallow one. The milk-room, too, is entirely different from those common in England. It is generally a plain apartment with flagged floor, and a gutter down the centre. The milk-pans are either set upon a small raised stone or brick shelf upon two or three sides, or within a wide gutter, which is formed by brickwork being set about twenty inches from the wall, this being either partially filled with water, or so arranged that water is continually running through it. In some milk-rooms, however, there is hardly any system, the milk cans being placed at one end of the apartment in any position on the main floor. As a rule the churning and working of the butter is not conducted in this apartment, which is reserved entirely for milk. There are three systems adopted in raising the cream. Sometimes it is skimmed from perfectly sweet milk; and the butter made from this cream is usually sent to Paris, and obtains the highest possible prices, for the Parisians demand excessive mildness in their butter. In other dairies the cream is allowed to remain until sour, not being taken off the milk until the latter has turned, and has become a thick curd. The farmers correctly believe that they obtain a larger yield of butter by this means, and they find that it procures a finer flavour, which is preferred by a large class of consumers. This butter also keeps better if it is thoroughly well made, but not unless. Another system which we have

seen adopted in the department of La Manche is that of artificially souring the milk. The milk-room is placed behind the kitchen, so that a communication can be made between the flue and the milk-room. At a certain time in the day a slide is opened, and a quantity of hot air is sent into the milk-room, which is at all other times exceptionally cool, and the sudden change turns the milk. In these cases, upon lifting the cream in the pans with the skimmer, the milk underneath is found to be an absolutely thick curd. This curd the farmer uses for two purposes: in some cases for his men, and in others for his calves, which are entirely fed upon it until they are fit for the Paris butcher, when they are sent up in the form of large veal. This fact is worth noting as affording another means of utilising the skimmed milk with considerable profit. In churning, which practice is, generally speaking, conducted in time for the markets of the districts once or twice a week, as the case may be, the barrel churn is almost invariably used, and in large dairies two are worked at the same time by means of a connection through the wall, with a horse-gear outside. A number of different churns have at times been exhibited in these departments, but the farmers do not take to them, and the barrel may be seen everywhere. The churn is generally turned at a slow pace until the granular butter is formed; and much importance is attached to this, for the cleansing, and, we may almost say, the working of the butter is conducted within the churn. This could not possibly be done if it were converted into lumps before churning was stopped. Where salt is used it is almost invariably mixed with the butter in the churn, and any practical

dairyman will see, after a few moments' reflection, that, where mild salting is practised, there can be no better opportunity of thoroughly amalgamating it with the butter than by pouring it into the churn in the form of brine while the butter is in this granular form. Every particle of butter-milk is washed out, and the butter can be salted to the greatest nicety by means of careful washing after the brining process, thus modifying the strength of the salt to the required taste. When this is done the butter is taken out, very slightly worked, and made up into huge lumps or cones, and placed in baskets of appropriate size, ready for market or despatch by rail to the large blending houses, where it is graded—blended with margarine or with other samples of similar quality, coloured, and if necessary salted for England. Naturally, in some cases, it is put into pots either for the merchant or for shipment: in others it is prepared, in the form in which it may be seen in London shops, in pound or half-pound rolls, or in kilogrammes or half-kilogrammes. The churning process usually takes place in an apartment adjoining the milk-room, also paved with stone, and plentifully supplied with water, these two materials being a *sine quâ non* with the French dairy farmer. On the best dairy farms there is generally a drainage system for carrying waste milk and butter-milk into the piggeries, although these are sometimes at a considerable distance.

Cheeses.—It might almost be said that the variety of cheeses of France is greater than that of all the rest of Europe put together. We should not be surprised if this were the case: at all events the number is very

large, although many of the cheeses are quite local and almost identical with those made in other parts of the country and known under other names. French writers divide them into two classes, hard and soft; the latter being sub-divided into new and ripe cheeses, and the former into (1) pressed and salted, and (2) cooked and pressed cheeses. New cheeses are found in almost every market in France, and in several forms. Thus they are made by large milk dealers in the cities from surplus milk which they cannot hope to dispose of in any other way. Small farmers manufacture them from skim-milk, and send them into the markets in a very tasty form at a very low price, while others with greater skill make new milk cheeses, or cheeses of combined new milk and cream, which realise good prices, giving them names such as Bondon, Neufchâtel, Normandie, Malakoff, Suisse, double cream, etc. The perfected or refined soft cheeses, which are seldom sold until completely ripe, and which are both made and ripened, and purchased and ripened by the farmers, include those of Normandy—the principal of which are Camembert, Livarot, Pont l'Evêque, and Mignot—those of the departments of Seine, Marne, Oise, Meuse, etc., which include Brie in its various forms, *e.g.*, Brie de ferme, Brie courant, Brie de saison, the Coulommiers Brie—also the Troyes, Barberey, Eroy, and the Chaource; together with cheap imitations of both Brie and Coulommiers. Again, among numerous other soft cheeses popular in France are Mont d'Or, Rollot, Marolles, Langres, Void, Géromé, St. Florentin, Olivet, Bourgogne, Macquelines, Thury, Munster, Compiègnes, and Senecterre. Among what are called *fromages à pâte ferme*, or hard cheeses,

are Roquefort, imitation Roquefort, Journiac, Septmoncel, Gex, Mont-Cenis, Sassenage, Cantal, Languiole, and a variety of other cheeses of the Auvergne; also Hollandes Française, or French-made Dutch, fromage de Bergues, Gruyère and its imitations, Rangiport, Port du Salut, and the *fromages* of the Pyrénées, also a variety of others made from the milk of goats and sheep.

The descriptions following relate to a selected number of varieties which are at the head of their respective classes, and which are slightly varied in different departments.*

Brie.—In the manufacture of the Brie cheese the rennet is added to the milk as the latter comes from the cow, and in a general way one particular make, that of Boll, is preferred rather than home-made rennet. Thus it is always of one strength, and a proper quantity can be added without difficulty. Eight-twentieths of a cubic centimètre are used for each litre of milk. The mixture is set in a tin vessel holding about forty litres, and after being slightly stirred with a spoon it is left in a room at a temperature of 65° F. It may be added that in summer-time, in spite of the evenness of the temperature, six-twentieths only are required to obtain the same result. At the end of four hours the curd has become firm and elastic to the touch. It is then placed in moulds made of tinned iron, two being used for each cheese, and varying in diameter, some cheeses being twelve inches across, and others not more than half

* See also "British Dairy Farming," illustrated by the writer of these lines, published by Chapman & Hall, in which this department is exhaustively treated.

that size. The top mould fits into the bottom one, and the curd is filled to its rim, so that when it has drained and sunk considerably this is taken off. The top mould is 2 inches, and the bottom 2½ inches in depth. The curd is fit to move when the whey rests on the top quite clear and bright. For ladling it into the moulds, a slightly concave tinned iron plate is used. The moulds stand upon small round boards called planchettes, upon which straw mats are laid, the boards being placed upon fluted benches made of cement, from which the whey drains off. At the end of three hours, when the top mould is taken off, a dry mat is placed on the top of the curd, and a clean board laid over this, when the cheese in the bottom mould is inverted and left to drain for eight to ten hours. Next day fresh mats are used in the same manner, the straws being laid in a contrary way to those of the previous day, so that the cheese is marked evenly on each side. The mould is next removed and the plain cheese left upon the sloping boards, having been first salted with very fine salt, sprinkled by the left hand and spread by the right, by means of a goose-quill. At the end of twelve hours each cheese is laid upon a round willow frame called a *clayette*, which is placed on the top of the cheese, this being at once inverted and the mat beneath removed. The cheese is next taken to the drying-room, and salted on the rim and the outer face, and placed upon shelves to dry, plenty of air being necessary, and this should be passed through the room in as energetic a manner as possible. The cheese is turned morning and evening, a clean *clayette* being used each time. On the third or fourth day a white mould appears in large patches, and when this

has covered the face of the cheese it is taken to another apartment, where the currents of air are stronger, but are regulated at will as it may be found necessary to hasten or retard the development of ripening. Here the cheeses are placed upon dry mats resting upon boards, and turned every twenty-four hours, the mats being changed each time. The mould becomes blue at the end of a month, when it is the custom of the farmers to sell the cheeses either for immediate consumption or for further ripening by the merchants.

Coulommiers.—In the manufacture of Coulommiers, which resembles Brie in almost every particular, the rennet should not be added at a temperature exceeding 77° F. The quantity per litre of milk is from one and a half to three-twentieths of a cubic centimètre, according to the season, the curd standing thirty-six hours in an apartment at 64° F. before it is touched, when it is softer and less elastic than that obtained in the manufacture of the Brie. The remaining portion of the process resembles that of the Brie; but it may be added that the cheese is much smaller in diameter, ripens much quicker, and can, in fact, be eaten with greater relish on the eighth or tenth day from its manufacture, when the Brie at this period would be tasteless.

Géromé.—This is a soft round cheese, weighing from 4 lbs. to 8 lbs., and sometimes made with the addition of aniseed. The milk is coagulated at the temperature at which it comes from the cow, and is placed in a deep copper vat holding some 40 quarts, and covered

with a lid, in the centre of which is a wooden funnel. To the bottom of this is attached a cloth for straining. The rennet is home-made, and the quantity added varies according to its strength, which can be ascertained with a little practice. The curds and whey are divided with a ladle in half an hour, and the vat covered for a second half-hour, when the division is continued until the curd has formed into small pieces about the size of a nut. When this has been accomplished it is taken out and put into cylindrical moulds 5 to 9 inches in diameter, two being used to each cheese, the one fitting into the other. The larger one is pierced with a number of holes for drainage. The height of the two moulds when fixed is about 14 inches. At the end of twelve hours the curd will have sunk into the bottom mould, when the top is taken off. It is now called a cheese, and changed into a fresh clean mould, and placed upside down upon a shelf. In six hours it is again turned, and it is twice turned during the two following days. When draining, the cheeses are always put upon a sloping shelf from which the whey can run off. The temperature of the room in which they are made is about 60° F. Salting is next performed, the two surfaces being well sprinkled; and this operation is repeated every three or four days, the cheeses being turned each time. Turning is continued for three days after salting, and the surfaces moistened with tepid water. When a dry crust has formed, they are removed to the drying-room, or *séchoir*, in which large numbers are kept in a small space, the aëration and temperature being perfect. When thoroughly dry, the Géromé cheeses are taken to the cave or ripening

cellar, where they must be carefully managed. The largest remain here some three to four months, and are frequently turned and washed with slightly tepid water during the time. As soon as they are brick-red in appearance, and sufficiently firm to yield to the pressure of the finger, they are marketed. A good Géromé is firm, rich, and oily, with a few small holes in the centre, in this respect somewhat resembling Gruyère.

Livarot.—One of the most popular cheeses in France, and one which is not only profitable in its manufacture, but well adapted for production by our dairy farmers, is the Livarot, which takes its name from the town of Livarot in the department of Calvados, the principal centre of its manufacture. To the workmen, who consume immense quantities of it, it is almost indispensable. The milk taken from the cow is creamed on the following day and poured into large wooden tubs, holding about 50 gallons, being then brought to the temperature which it possessed on leaving the cow. The rennet is then added, in summer one, and in winter two dessertspoonfuls being required for every 6 gallons of milk. As a rule this is made on the premises, several calves' stomachs being cured together, for each of which a large spoonful of salt and there glasses of water are used. In one or two hours the coagulation is complete, when the curd is broken up and laid upon rushes or a clean cloth. Before placing in the moulds, it is necessary that the curd should be reduced to small cubes no larger than lumps of sugar. After having been left to drain for a quarter of an hour, the curd is placed in the circular wooden moulds, where

it completely drains and attains a proper consistence. This result can be obtained in three or four hours if it is warmed, but the quality of the cheese will be impaired. Moreover, it must not be left too long in the moulds—one to four days, according to the season of the year and the temperature, being quite sufficient. The moulds are turned over one hour after the curd has been placed in them, and this operation is repeated half a dozen times before the cheeses are released. They are salted with the hand, and left for four or five days on inclined wood or stone tables, and then taken to the *hâloir*, or the market. The *hâloir* is an apartment with windows let into opposite walls, through which a current of air passes for the purpose of desiccating the cheeses placed in them in various stages upon the lath racks, which have been previously covered with straw. In this place they are left for fifteen to thirty days, and then taken to the cave, all the apertures of which are closed, and in which a uniform temperature is kept. In consequence of the gas given off from the cheeses, the walls are not made of brick or stone, but of mortar mixed with chopped hay. The cheeses, placed on planks, are turned twice weekly in winter, and three times weekly in summer, being slightly wetted each time with pure water, and salted afresh when necessary. At the end of eight or ten days in the cave they are set on their edges on a species of sedge to assist the process of drying. They remain in the cave for three to six months, according to their size, and, when packed for transmission to market, are coloured with annatto. It requires about five pints of milk to make a cheese; and September and October are the months chosen in which to

commence the process of manufacture. Several makers of Livarot cheese manufacture from 5,000 to 8,000 dozen in a season, besides purchasing many white ones to perfect in their own caves, which sell at $3\frac{1}{2}$ to $8\frac{3}{4}$ francs per dozen, and ultimately realise 15 to 20 francs, or, during Lent, 20 to 30 francs. At the Lisieux market, one of the best in the Department, three varieties of cheese are sold—white cheese, which is eaten fresh and is most delicious, at 2d. retail, or 1.20 to 2 francs the dozen; Camembert, of medium quality, from 4 to 5.50 francs; and Livarot, which varies from 9 to 11 francs the dozen; while at St. Pierre about 1,000 dozen are sold in the market every week, at an average of 7 francs the dozen. At the markets of Vimoutiers, Livarot, Lisieux, St. Pierre, and at Lisieux Station, very large quantities are also sold; and, since 1866, the total value of the cheeses manufactured has more than doubled.

Journiac.—This cheese is made to resemble Roquefort, but instead of being manufactured from ewes' milk it is entirely composed of the milk of the cow. The following is the system adopted at the farm of M. Laforce, who resides some 3,300 feet above the level of the sea. When the milk comes from the cow it is poured into a wooden pan, made of pine, which will hold the milk from a hundred cows. It is then carried to the cheese-room, and the rennet is immediately added. After the curdling and the separation of the whey are complete the curd is placed in cheese-moulds made of tinned iron, in which it is left to drain for three or four days, and afterwards carried

to the cave, which is kept at a uniform temperature of 77° F., where it is constantly watched and attended to by special workmen. Every cheese is turned daily and frequently sprinkled with fine white salt. After a short time they are removed to other caves, which are much colder and provided with strong currents of air. Here they are placed upon their sides and pricked to the centre with needles in order to place in contact with the air a fine meal composed of rye, wheat, and barley-meal, which, at the moment of placing the curd in the cheese-moulds, was laid within the body of the cheese. This composition, when properly made, gives rise to the formation of a blue mould in the interior of the cheeses; and if the colour is of a fine blue it is classed as first quality, providing of course it is of equal flavour. During the time the cheeses remain in the second cave they are daily rolled and scraped, in order to avoid spontaneous growth of foreign fungi. They are usually ripe at the end of two months, and despatched for sale in cases holding one dozen each.

Mont d'Or.—These very delicious small cheeses are made of new milk, either by the addition of the morning's to the evening's, or twice a day. The rennet is not added to the milk, but the milk to the rennet, this being placed in the vessel in which setting is to take place. When thoroughly firm the curd is broken up and placed in single hoops, similar to those used for Coulommiers; these, however, being placed upon larger hoops, which are made of wood, and on the top of these a couple of straw mats are laid to encourage draining and prevent curd passing through. The

diameter of the metal hoop is from 12 to 13 centimètres, and that of the wooden one a shade more, the height of each being about 8 centimètres. When the moulds are filled, they are placed upon a fluted inclined shelf in order to drain, each cheese being turned at the end of two hours, when clean mats replace the wet ones. Next day the same process takes place, when they are carried to the *séchoir* for further drying, shelves covered with rye straw being provided for the purpose, and the cheese is here taken out of the mould. Turning takes place four times a day, but there is no salting other than that which results from a continual damping of each surface with brine. When sufficiently dry, at the end of two or three days the cheeses are removed to the ripening-room, where they remain for a week during warm, and a fortnight in cold, weather.

Roquefort.—It is only necessary to refer to the Roquefort cheese—to state that it is made of sheep's milk, that the system of manufacture is somewhat intricate, and that, as it is not likely to be attempted in this country, we do not deem it necessary to give a detailed description.

Neufchâtel.—This little cheese, which takes its name from the little town in the Brie district, in the Department of Seine-Inférieure, is largely imitated by milk dealers in London, who find the system a ready way of disposing of their surplus and sometimes spoiled milk. It is sold both new and ripened, and is made from poor and rich milk respectively, those

made from skimmed milk being largely consumed by the poorer classes. The milk is coagulated in vessels holding about twelve quarts, the rennet being added when the temperature is about 90° F. The pans are left from thirty-six to forty-eight hours, after which the curd is deposited in cloths, which are hung to drain over square forms, the corners of the cloths being fixed to the four corners. It is next put into a dry cloth and slightly pressed for nine hours or more if the whey is not extracted. Being now tolerably solid, it is placed in small cylindrical moulds, which give it its shape, salted at the ends, placed on planks in rows, and carried to the perfecting or ripening cellar. In a few days a white mould appears, and it is then ready for the market as a new cheese. If ripening is to be complete it remains much longer and is regularly turned. One pound of rich milk is estimated to make a cheese, so that as a gallon will make ten, and the poorest cheeses realise a penny each, the maker does remarkably well with his milk. Naturally the prices vary according to the quality, some makers preferring to add cream to the milk, while others use skim-milk only. There are a variety of ways of manufacturing these white cheeses, whether they are to be ripened or not. In some cases a mould is used which resembles a small box about 3 inches high by 4 inches square, holes being pierced in the sides. In other cases a similar box is used, which stands upon four legs; and in others again a heart-shaped wicker frame is adopted, or a round mould of wood in which holes are similarly pierced. The curd of skim-milk is used in several forms for the manufacture of fresh soft cheeses, and is even sold in its new

state for that purpose. In some cases, where it has been made at a temperature of 80° F., it is mixed with a small quantity of cream, and when the two are thoroughly amalgamated the mixture is put into small moulds, and left to drain; but the curd must be particularly soft or the amalgamation will not be perfect. Little cheeses of this nature can be made in so many ways that it is not surprising the French take so much trouble to understand and manufacture them, and that we should be able to see such numbers of different varieties in their country markets.

Camembert.—This is the most popular French cheese among English consumers. It was invented nearly a century ago by Marie Fontaine, ancestress of the Paynel family, some of the best makers of the present day, the farm of one of whom (Mesnil Mauger) we visited, to see the process of manufacture, several years ago. It takes its name from the commune of Camembert, in which Mdlle. Fontaine resided. The cheese is made from whole milk, and cream is not added as is popularly supposed. There are imitations made of partially skimmed milk, which are now flooding the English market, but they do not possess the quality of the real article. A portion of the morning's milk is added to the milk of the previous evening, this being heated in a tub to temperatures varying between 80° and 90° F., when the rennet is added, the quantity depending chiefly upon its strength and the time of the year.

As an even quality of rennet is very important, some makers prefer not to manufacture their own. We have always found patent rennet answer the

purpose better than rennet of any other kind, producing cheese of the finest quality. When mixed, the milk is stirred for two or three minutes. It is then covered and left for two to four hours, according to the season, and when the finger can be laid upon the surface without curd adhering, it is ready for work. The curd is next taken out with spoons, and placed in small cylindrical metal moulds, some four inches in diameter, in which the cheese is shaped. These are open at both ends, and stand upon rush mats which are laid upon sloping tables, with gutters at the ledge for carrying off the whey as it runs down from the cheeses. As a rule 2 to $2\frac{1}{2}$ litres of milk are required to make each cheese. After remaining all day in the moulds, the cheeses are first turned, with the faces upon clean mats, and left to drain until the next day, when they are again turned. When quite firm they are taken out of the moulds, rapidly salted, placed upon wooden shelves, and left for two or three days, being regularly turned until they are ready to send to the drying-room, where they are laid upon shelves covered with straw. This drying-room, or *hâloir*, is specially designed to admit as much air as possible, the more energetic the current the better; although it must not be carried straight through from window to window, but arranged so as to affect the whole apartment, as shelves are placed from top to bottom. The windows must also be covered with fine wire gauze, to prevent the entrance of insects and dust. The cheeses must be daily examined while under the drying process, and turned or removed as may be required. They remain in this apartment from fifteen

to twenty-five days, according to the season. During the first week they are turned daily, and afterwards every other day. About the tenth day they become covered here and there with fine white patches of mould, which gradually extend over the whole cheese. They are not removed until they no longer stick to the fingers when touched. The next process is that of ripening in the *cave de perfection*, or curing cellar, which is an apartment with glazed windows and interior shutters arranged to prevent the entrance of the sun. The temperature must be low—about 50° F.—and the apartment slightly humid. Too much moisture is not desirable, and the floors are often paved to prevent this. Shelves are built round the room, and upon these cheeses are placed according to their age. As they are taken from the top, the lower tiers are removed up, and space left for new cheeses as they arrive—a foot dividing each shelf. The cheeses remain here from ten to twenty days, during which time the most constant attention is paid to them, for they are turned almost every day, and every phase of fermentation watched, and assisted or checked as may be found necessary. On some farms they are made all the year round, large dealers purchasing the cheeses from the smaller makers in their new state, and drying and ripening them themselves in their own specially prepared apartments.

The most imperfect ripening is that of summer; hence cheeses are seldom made by farmers during the hot months. When the process is complete, each cheese is wrapped in paper and packed away in sixes, and again wrapped up and packed in wooden cases or willow baskets in wheat chaff, and despatched to the

markets. In the best season they reach 6*s.* 6*d.* to 7*s.* 6*d.* a dozen, but in summer they are often sold as low as 4*s.*—realising, however, 7*d.* to 8*d.* each in the London markets. Upon the average, it takes 2 litres to make a cheese of 300 grammes, or about 10½ ounces. M. Paynel used 1,000 litres of milk daily when making Camembert, and turned out some 500 cheeses per day, these yielding him an average of 6*s.* 6*d.* a dozen. A good Cotentin cow is expected to give 3,000 litres of milk, or about 1,600 cheeses, which, at 5*s.*6*d.* a dozen, would be nearly £35. In the Department of Calvados many farmers make from 10,000 to 160,000 cheeses each; while from the village in which M. Paynel resides, twenty-four makers in one season sent out 62,000 dozen. The price of Camembert cheese, however, has fallen since our visit to Mesnil, and the competition in the English market is now very keen.

Mignot.—This cheese receives its name from the family of Mignot, who were the first to make it. It is made in two varieties—the new or white cheese produced from April to September, and the Mignot *passé* from September to April, the latter being the more valuable. The milk of the morning is creamed in the evening, and mixed with the evening's milk. It is then heated until it slightly scalds the finger, when it is poured into earthen vessels and a spoonful of rennet added to every 40 litres. It is next placed near the fire, and left from eight p.m. until six the following morning, being covered the while with a double cloth with a small hole in the top to prevent souring. The coagulation is very slow, but when it is effected the work of manufacture is proceeded

with as in the case of the Pont l'Évêque, with the exception that the Mignot is drained less than that cheese. In making the white cheese, the midday milk is skimmed in the evening, and mixed with the evening's milk, both being warmed as before-mentioned. It is then placed in earthenware vessels and covered with a cloth until the next morning, when it is skimmed and used with the new milk of the morning, after which the rennet is added. The rest of the process is as for the Mignot *passé*, both cheeses being subjected to very slow drainage of the whey. They are rapidly made, salted upon the evening of the day they are put in the moulds, dried almost without air, and despatched to market a day or two afterwards. When ripe, the Mignot has a rich golden colour, and resembles the Livarot and Pont l'Evêque in flavour. It is made in both round and square forms, and reaches 4*s.* to 5*s.* a dozen in winter.

Pont l'Évêque.—This popular little cheese is made in the district of the town from which it takes its name, between Lisieux and Honfleur. Its original name was Angelot, or, as some think, Augelot, from the valley of the Auge (Oise). It is now made in three qualities, according to the quantity of cream used in its manufacture. In the first quality the *fleurette*, or first cream, is added to new milk after milking; or with some makers pure milk is used alone. The second quality is made from the morning's milk which has been added to the evening's milk after skimming; while the third quality is made from the skim-milk of three milkings, without any addition of new milk. In autumn four milkings are sometimes mixed, but in summer seldom more than two;

while in winter five and even six are occasionally used. In making cheeses from new milk, the latter is placed upon the fire until lukewarm, when the rennet is added, and as in the case of the Camembert, just sufficient is used to cause coagulation, too much giving a disagreeable flavour, and causing too active a separation. No rule as to quantity can be given, this being ascertained only by practice with the particular rennet. The milk is stirred with the hand, and left for about fifteen minutes, when the whole becomes set. It is then cut to the bottom of the vessel with a wooden knife, and left five minutes after being covered with a cloth. The curd is next taken out, and laid upon reed mats, called *glottes*, where it is left to drain for a short time. The square moulds, made of ash or beech, are then filled with curd and placed upon the same mats until drainage is complete, these being turned several times during the half-hour following the operation, and many more times during the day. After being continually placed upon fresh dry mats of a similar kind, in forty-eight hours the cheeses are taken from the mould, and salted with fine dry white salt. One side is salted in the morning and the other in the evening, only a small quantity of salt being used. They are then taken to the *séchoir*, or drying-room, and placed upon long shelves suspended from the ceiling. This apartment is aired or ventilated, as described above. The cheeses remain equi-distant from one another for two or three days, and are turned only once a day, and when dry they are carried to the ripening cave or cellar, and laid close to each other in boxes, this close proximity being supposed to assist their ripening. Great care must, however, be exercised ;

they must be frequently examined, and turned over every two days, and afterwards stood upright, and finally flat one upon the top of the other. They remain from two to four months in this apartment, according to their size and quality; the richest remaining for a less period than the poorest, and if these are small and thin, fifteen to twenty days is often sufficient to perfect them. Poor cheeses which are kept for a long period sometimes become too hard, when they are enveloped in a cloth damped with whey, this process making them more tender. A well-made Pont l'Évêque cheese retains its qualities for a year, and even two years, if properly taken care of; but it must be prevented from coming into contact with damp and too much air. The richest cheeses are made in the autumn, the mid-summer cheeses being generally from milk which has been skimmed for butter-making. This cheese has a tendency to harden, but this is prevented in a great measure by the addition of a little boiling water in the milk when it is put together. Milk used for the manufacture of this cheese in summer must not exceed a lukewarm heat, or it will become too hard, whereas in autumn and winter the makers prefer that it should slightly burn the finger.

In making the second quality of cheese, a litre of boiling water is generally added to six or seven litres of milk, a little more being used in autumn than in summer. In making the third quality the makers simply boil the water, which is poured into the milk, the latter not being heated at all. Great care, however, is needed, as old milk is liable to turn. This cheese must be eaten quickly, as it will not keep more than about

three months, but otherwise it is almost as fine as cheese made from whole milk. It becomes a velvety blue in three weeks, showing that it is ripe, when it should be at once marketed. To make a good cheese valued at 1s. 3d., 4 litres of new milk are required; and 5 to 6 for a 2-franc, or 1s. 8d., cheese; thus 4 litres, valued in England at about 7d., produce a cheese worth double the money, in addition to the whey, which would increase the return. The richest of these Pont l'Évêque cheeses, called "Bespoken," and made of two-thirds whole milk and one-third cream, are seldom marketed, but reach from 30 to 40 francs per dozen, and are found upon the tables of the rich in Paris and other parts of France. Many of the farmers in the district manufacture from 4,000 to 5,000 cheeses per annum.

St. Marcellin.—This cheese is made from goat's milk, unskimmed, and derives its name from the district in which it is made. The cheeses weigh from about 4 to $4\frac{1}{2}$ ounces, and, if eaten fresh, should be consumed within twenty-four hours. In hot weather they are considered particularly agreeable, though called cheeses of the third quality. The rennet is manufactured according to the custom of each particular farmer, but is generally made from calves' vells and white dry wine. No definite rule can be given as to the quantity to be used, as this varies with different makers, and according to its strength; but a little practice will determine this point. If too much is used the cheese becomes slightly sour. In winter the milk is heated a little before working commences, but

not in summer. When the milk is curdled, it is placed in small goblets or mugs, holding about two pints, which are perforated all over the surface. After it is sufficiently drained, and unable to lose its form, it is quickly salted, taken from the moulds, and placed in an apartment upon a shelf, on which is a layer of rye straw. This apartment must be well aërated and in a sheltered position, and the cheeses turned and salted daily during the hot weather; once every two days being sufficient in the cold season. When they commence to dry, the crust assumes a yellowish, and subsequently a blue, colour; and in this state may be marketed as cheeses of the second quality. In order to make a more perfect article the cheeses are placed in a closed compartment in a cellar, being always laid upon straw. Here they take a blue, and then a yellow, mould, and are considered to be of the best or first quality. The chief feature in the manufacture of St. Marcellin cheese is, that the most rigid cleanliness is observed in every operation. Second and third qualities can also be made from unskimmed cow's milk, while good cheeses may be manufactured by adding to the goat's milk 25 per cent. of milk from the cow. It is questionable, however, whether we in this country can make so tasty an article in the absence of the peculiar and exceptional pasturage cultivated by the French farmers of the district in which this cheese is made.

St. Remy.—The milk and rennet are put together for the manufacture of this cheese, at a temperature of 95° F.; 10 to 12 grammes—a third, or a little over a

third of an ounce—of rennet being used for every 100 litres of milk. If the milk is not set direct from the cow, it must be warmed until it reaches the required temperature. St. Remy cheese is sometimes made from mixed milk and sometimes from new milk, according to the system of the maker. The curd is usually formed in from twenty to twenty-five minutes; but if at the end of this time it is not fit for use, a small additional quantity of rennet is added, without re-warming the milk. When firm it is cut into pieces with a utensil made for the purpose to assist the separation, and it is then left for half an hour, after which the whey is removed and the curd placed in the moulds, which are allowed to stand upon a sloping table until late in the afternoon, or six or seven hours from the time of commencing the work, when they are turned and left to drain until the next morning. They are then salted for the first time, and again turned and left for twenty-four hours. Next day they are again slightly salted, and when fairly dry are placed upon small plates or dishes, and laid upon shelves and turned two or three times daily; the plates, which are of wood, being moistened each time. If they become at all hard they are washed with lukewarm skim-milk, with the aid of a brush. When thoroughly drained they are put upon drying shelves until quite dry and fit for the refining cave; but before being taken here they are usually passed through some fresh water, whatever the season of the year may be. When in the cave, which is a particularly cool cellar, they are washed at least twice a week in summer with a brush, care being taken to remove all

mouldiness as it appears; but the washing is not needed so much as they proceed in the ripening process.

GERMANY.

There are a variety of systems in force in the different countries of which this nation is composed, but it is not necessary to refer to any other than that which is general in North Germany, for in the South butter-making as well las cheese-making is conducted in an old-fashioned manner, which would afford no instruction to the modern dairy farmer. North Germany has become an important dairy district, since the first factory was built at Kiel, this having been but the precursor of many others which are now in full work in various parts of Sleswig-Holstein, Brunswick, and Hanover. Perhaps the most intelligent portion of North German dairying is in connection with these factories, to which the farmers send their milk for conversion into butter and cheese, receiving in return a sufficient sum to pay them well for their trouble. Home dairying in Germany is neither advanced nor especially intelligent, and cannot compare with that of either France or Denmark; but scientific dairying is equal to that of either country, for German scientists in this department have no superior in Europe. As in Denmark, it is the custom in the factories to manufacture keeping butter, much of which is sent out in little round pots with covers, which hold a kilogramme (a little over 2 lbs.); and which, being salted, will keep for a length of time. The butter is invariably made from cream which has been soured, whether it has

been separated by the centrifugal machine or raised in the Swartz vat; and it is almost invariably churned in a vertical churn known in this country as the Holstein. As a general rule, the farmers who conduct their own dairies churn until the butter has become solid, when they fail to thoroughly cleanse it, and often salt it too highly, but great efforts are being made to educate them and their families in the various dairy schools which are numerous in Germany. In the factories an excellent system is conducted; the milk is heated after its arrival, skimmed by the separator, and the skim and butter milks largely used in the manufacture of cheese. Most factories sell cream in two qualities, as is sometimes done in London; and they also sell skim-milk and butter-milk to the poor, their vans being seen in every large city, with the taps of the cream, new, skim, and butter milk outside, with the prices of the day painted over each. Some Germans also use their butter-milk for their horses, for which it is a valuable food, and said to pay much better than giving it to pigs. Pigs, however, are largely kept for the purpose of consuming the whey and such milk as cannot otherwise be disposed of. There is perhaps more care taken to prepare foods for the poorer classes than in any other dairying country; for, in addition to the milk above mentioned, curds are largely sold at $1\frac{1}{4}d.$ a pound, much of which is made from butter-milk, while skim-milk and butter-milk sell at remunerative prices. The principal cheeses made in Germany are also particularly adapted for consumption by the poor, and of these we may specially name the Limburg and Backstein; the latter being made in varieties known as Lab käse, Hartz käse, and Saur käse.

The Limburg Cheese, which is also largely made in Belgium, and which is almost the only dairy product at all famous in that country, is manufactured from skim-milk, and realises in North Germany about 2½*d.* a pound to the maker, selling retail at 3*d.* each. It is made from milk at a temperature of about 95° F., sufficient rennet being added to set the curd in forty minutes. There is no great art in its manufacture, for immediately it is fit to work the curd is ladled out of the vat and placed in the moulds upon a table made for the purpose. This table may be two yards long by two and a half feet broad, one end being higher than the other. It is divided into squares by movable partitions, which may be made of wood or tin, so that when these are fixed in position there are a number of moulds or divisions four inches square. These divisions are perforated, and along the bottom of the table are very small fluted channels for carrying off the whey. Sometimes the curd is laid on the tables before the divisions are inserted, these being placed in the curd when it has become firm. On the following day the cheeses are formed, taken out and salted, being turned several times for three days upon the shelves upon which they stand, when they are taken to the drying-room, and remain sometimes for a considerable period. Occasionally the Limburg is sold fresh, but it may be kept until thoroughly ripe, at the end of two or three months, when it obtains a higher price. 100 litres of milk (22 gallons) usually make 8 kilogrammes (about 18 lbs.) of cheese.

The Hartz Käse is made from skimmed sour-milk at

a temperature of 90° F., the whey being completely separated from the curd by the process. At the end of a few hours the curd is dipped out of the vat and placed on a similar table to that used for the Limburg, but in addition it is pressed by weights which are put upon the top of each cheese. In a short time the curd is then placed in a mixing-tub and salted at the rate of one ounce of salt to three pounds. It is then ground, worked, and once more placed in the moulds upon the table. They are next again slightly pressed, taken out of the moulds and put upon the shelves of the cheese-room to dry, being turned at first twice a day, and afterwards once only. They are then taken to the curing cellar; but, unlike the French, who encourage a growth of fungus, this is destroyed as rapidly as it appears, by being brushed off.

Backstein.—There are a variety of systems by which this cheese is made, although they do not materially differ; it is manufactured either from skim or half-skimmed milk at a similar temperature to that adopted for the Limburg, being also converted into curd in the same period of time. After setting, instead of being immediately placed on the cheese-table, it is cut up into cubes to allow the whey to drain, and afterwards again cut into cubes for the same purpose. It is next placed in the wooded moulds similar to those used for Limburg; and when sufficiently solid, each cheese is taken out and treated in a similar manner to that which we have described above for the Limburg. There are also a variety of cheeses known by other names made in North Germany, but the systems of manufacture

closely resemble those already described. In the South, however, there are a few kinds which need not be referred to, as they resemble in almost everything but name those which we have described as being made in France and Switzerland.

HOLLAND.

Although the greater portion of the Netherlands is devoted to dairying, the chief dairying districts are North and South Holland and Friesland, each of which has its spécialité. In the first, the famous Edam or round Dutch cheese is manufactured, together with the almost equally well-known Campine butter; in the second, the flat Dutch or Gouda cheese is a staple industry, in addition to the butter of Delft; while Friesland is, perhaps, more famous than either for its butter, one port alone in this province having exported 400 tons in one season. In North Holland it is the custom of the dairy farmers to sell their worst calves at a month old, rearing the best for the dairy, and it is remarkable that throughout Holland larger numbers of cattle are kept per acre than perhaps in any other dairying country. In raising cream the Dutch farmer still uses the shallow pan, but it is of wood, although in many cases the Swartz system is fashionable. In South Holland the best farmers expect to realise 660 gallons of milk per cow, one gallon making a pound of cheese; and we are not surprised at this, for the size and milking qualities of Dutch cows are generally known. In the best dairies it is customary to skim at

twelve hours to make the first quality of butter, and at twenty-four for the second; but twenty-four and thirty-six hours' skimming are most frequent with the small farmers.

In the manufacture of Delft butter the milk is first cooled in copper vessels, which stand in very cold water for two hours. It is then transferred into shallow pans in a cool dairy, skimming taking place at twelve, eighteen, and twenty-four hours. The churns used are exceedingly primitive and much inferior to those adopted in this country. The working of the butter is done by hand; but as a general rule it is not thoroughly well washed nor too carefully made, but the salting and packing are exceedingly well managed. Although an immense quantity of butter is imported into this country from Holland, there is very little of high quality, or such as our makers need attempt to produce, the greater part of it being an imitation, in the art of producing which the Dutch seem to have long taken the lead. There are numerous factories in Holland, and large quantities of inferior butter, especially Campine, are made for the purposes of mixing with, and giving a character to, the imitation they turn out.

Edam.—The most famous dairy products of Holland, so far as British consumers are concerned, are the Edam and Gouda cheeses. The former is the round, red Dutch, and we have seen it made as follows:—The rennet is added to the milk at a temperature of 90° F., and in twenty to twenty-five minutes it is cut with an instrument resembling a lyre with a dozen strings. After standing for a short time for the separation to

take place, the whey is taken out and the curd afterwards thoroughly worked by the hand; when fit, the curd is placed in the moulds which, in this case, the cheese being globular, are divided into halves. When full, the two halves are pressed together, and pressed as tightly as possible. The solid curd is next taken out, a cloth is wrapped round it, and it is placed in fresh moulds, and subjected to pressure in a lever press until the next day. The moulds are placed in dishes to catch the whey, and the same pressure is generally exerted upon several cheeses at one time. At the end of some hours the cheese cloth is removed, and the cheese placed in a semicircular mould with a foot to it, and several holes perforated in the sides. A piece of flat board is then placed on top, and it is again put under the press. After sufficient pressure has been obtained, the cheeses are salted and turned daily for eight or ten days, at the end of which time they are soaked in brine and subsequently dried, coloured, and rubbed with linseed oil.

Gouda.—In the manufacture of the flat Dutch or Gouda cheese there is some resemblance to the Edam system; the rennet coagulating the milk in about forty minutes, after which time the curd is gently cut and the whey allowed to separate for ten minutes, when it is again manipulated. After another rest the curd settles at the bottom of the vat, and the whey is drawn off. Hot whey is then mixed with the curd, and it is again allowed to remain for a short time, the whey being subsequently removed with a utensil specially made for baling. The curd is afterwards

well worked and evenly broken up. It is then pressed in the bottom of the vat and again broken up, as a mill is not used. It is afterwards placed in perforated moulds (being previously covered with cloth) which are immediately put to press, the pressure being increased regularly until the following day, when it is turned and provided with a clean cloth. The cheeses are then laid in salt and water, where they remain for three days, after which they are washed with whey and taken to the drying-room. Here they are placed upon shelves, and daily turned until the second week, when turning is performed every other day. At the end of a month they are fit for sale, but it is the custom of some of the better makers to keep them for a much longer period, when the flavour is considerably improved and the consistence is more mellow. The Gouda cheese is generally made of new milk, but, as in all cheeses, there are many farmers who skim the milk once before they set it for curd.

ITALY.

Butter-making in Italy is not generally conducted upon a principle which can be termed either modern or perfect. Upon small farms, the cream, which is raised in open pans, often made of wood, is churned in cylindrical churns, the beaters within being turned instead of the churn itself. This is the general custom in Lombardy. In Piedmont it is quite common for the farmer to place his cream at 50° F. into a round box called a *Purragie*, which has a kind of spoon

attached to the axle. This is turned by a crank, and the revolution of the spoon is upon the inside of the periphery of the box. This process is rather laborious, and requires the services of two men. "The dairyman of Parma," we are told, "beats his milk with a cream whipper, and skilfully lets the floating cream, which gathers into a bucket, overflow into a fine-edged wooden bowl, and thence into the churn." In summer ten pounds of ice are added to thirty quarts of cream, while in winter the cream is heated, the temperature being usually kept at from 57° to 67° F., the Italians permitting a pretty wide margin. When in the churn the cream is beaten by two men alternately with a butter beater attached to a frame, this being raised and lowered by leverage. The butter forms in about forty to forty-five minutes, water being added if formation is desired quickly, and ice if it is necessary to retard it. The butter is worked by hand, formed in large lumps, and left to drain. In some parts of Italy it is customary to keep butter in bladders, a method which is considered very convenient, and which enables it to be kept for a length of time. There are a few excellent butter factories in Italy, some of which export butter to England and India; and, with the help of the modern dairy schools, with some of which we are acquainted, Italian dairying is likely to improve.

We have inspected some excellent cheese factories in Italy, numbers of which have been started since the year 1873-74, when the Government offered large prizes and gold medals to the best-managed associations. In Sicily, strange to say, small dairymen, instead of daily manipulating their own milk, take it

to the large cowkeepers, until they have delivered some 300 quarts. They then receive that quantity back at one time, and deal with it in the manufacture of butter or cheese, this system of reciprocity being found mutually beneficial. The Italian cheeses known in England are the Parmesan and the Gorgonzola. These popular varieties are very largely made, and we have devoted considerable time to a study of their manufacture, both in Lombardy and Parma.

Gorgonzola.—In making this cheese the milk is coagulated while warm from the cow, great attention being paid to the preparation of the rennet, the quantity required being only ascertained by experience. The curd is set in from fifteen to twenty minutes. The whey is then separated as much as possible, and the curd hung up to drain in coarse strainers. This process is conducted twice daily, after each milking. By the time the evening's curd is ready that of the morning is naturally cold; but the cheese is composed of the two, the cold curd being placed in the centre and the warm at the top and bottom. Thus each cheese is made up of three layers, and as the hot and cold curd never properly combine, two sets of interstices are, as it were, created, in which, as it matures, the well-known green mould forms, and adds to the cheese the delightful flavour which is so much approved in this country. During the first day of manufacture the cheese is turned three times, and on the following morning it is put into a clean cloth and salted, this process being continued for at least a week, sometimes longer, one ounce of salt generally being used to about

eight pounds of curd. In some cases the salting operation is conducted by a special process of turning and pressing against a salted surface, this giving a better crust to the cheese. The wooden mould within which the curd was placed in the first instance is not removed until the fourth day, when the cheese has commenced to ferment. At the end of twenty-five days a good cheese is generally a pinkish white in colour; but if it is inferior it becomes nearly black, the crust in this case being soft, and the body of the cheese rapidly deteriorating. If, however, the crust is hard, washing in brine will improve it. The temperature of the cheese-room is usually between 57° and 67° F. The ripening process commences in April, and frequently continues until August. One gallon of milk usually makes one pound of Gorgonzola cheese.

The Parmesan, or *Formaggio di Grana*, cheese is very largely made in Italy. In its manufacture the milk, often skimmed, is heated, according to its condition and age, from 77° to 86° F., although this is somewhat guess-work, for the distinction is almost invariably made by hand. The rennet, which is a pulpy material made from the actual stomach of the calf, is then added in the proportion of half-an-ounce to 500 gallons. The principle it contains is dissolved by the aid of a pestle in small wooden utensils made for the purpose, and filtered through a fine sieve directly into the milk vat. The curd having formed, is broken with a utensil called a *rotilla*, a disc being at the bottom end. The working is continued for forty minutes, with intervals every now and then, that the curd may be consolidated

but not hardened. When the whey is removed, half-an ounce of saffron is added to the contents of the vat per 80 gallons. The pan containing the curd is next placed upon the fire and heated for nearly an hour up to a temperature of 112° F., being stirred during the time with the utensil named above. When the curd has broken up into minute particles it is removed from the fire, and a quantity of the cold whey, which had been drained off, is added to the mixture to assist the curd in forming in a mass at the bottom, where it is gathered and squeezed with the disc of the rotilla. It is then loosened and drawn to the surface, where it is collected in a cheese cloth, and lifted out into a mould and there left in its wet state for an hour. After this it is placed in a box made of beech and bound with hoops. A cloth is placed over it, and a wooden follower, upon the top of which heavy weights are laid. In this state the whey is pressed out; but, after a few hours, it is again dipped in the whey, but returned to the mould after being enveloped in buckram,—this, by means of the pressure, giving the cheese the peculiar print which is always seen upon its crust. After some hours it is salted and then dipped in salt water and again pressed between the boards. The salting process is continued every other day for a fortnight, when it is taken to the curing-room and occasionally scraped, being finally well rubbed with oil. Parmesan takes a considerable time to ripen, hence the poorer makers sell to merchants who have splendidly equipped cellars for the purpose. In one such cellar near Parma we saw cheese valued at some ten thousand pounds.

There is a cheese made in various parts of Italy

similar to the whey cheeses which are made in two or three English counties. This is called Ricotta. The curd, if we may so call the solids obtained from the whey, is the solid matter remaining in the milk after the extraction of the casein and fat. This is sometimes placed in a vessel of cold water, well shaken, and afterwards pressed with the hand. In half-an-hour the surface of the water is covered with a scum. This is the fat or butter of the *ricotta*. In making the cheese, the whey is boiled, a little of the sour whey from the last making being first added. In this process, a scum also rises, which may be used at once in the form of butter, or converted into a regular cheese. It may be improved by several modes of salting and curing, or by the addition of sweet milk or cream.

SWITZERLAND.

Dairy farming in Switzerland is an important national industry; but in the mountainous cantons which are shut off from the outer world for almost half the year, where the cattle graze, and the cheeses are made at an altitude of some 7,000 feet, the system is exceedingly primitive. In these districts it is customary for one or two men to take the entire cattle of the village to the mountains for the summer, to live with them, milk them, and make the cheeses, a hut being provided for the purpose. Once a month the owners below visit the herds and test the quantity of each cow's yield; by this means the cheese is ultimately divided, and the herdsmen

paid. In the more fertile cantons, such as Zurich, Zug, Lucerne, and Schwytz, the young cattle are grazed upon the mountains, but most of the cows are housed the whole year round, getting grass during summer and hay during winter, cake and corn feeding being almost unknown to the farmers. The milk is usually set for cream in shallow wooden vessels, for almost every dairy utensil is made of wood in Switzerland. The cream is churned sweet, the churns resembling a *Gruyère* cheese or a small millstone in shape, and they are consequently difficult to manipulate and impossible to clean. The butter is exceedingly mild and seldom salted, but it must be eaten fresh, for it will not keep. In cheese-making, unless in the factories and on the best farms, the milk is turned by a primitive kind of rennet made of vinegar and sour whey, in which pieces of bread are soaked; and if we except the very beautiful copper cheese kettles, the finest appliance of the kind which we know, there are no good dairy utensils made in the country. The principal cheeses are—Emmenthaler, which we call Gruyère; Gruyère, which in the country is often a real skim milk cheese; Vacherin; and Schabzieger.

Emmenthaler.—In the manufacture of this cheese, the milk must be at a temperature of from 93° to 96° F. If, however, it is extra rich, it may be a degree higher, whereas for poor milk it should be a degree lower. Again, as in summer cooling is slower than in winter, it is not necessary that the temperature should be quite so high. The quantity of rennet added is usually 3 lbs. to 650 or 700 lbs. of milk, this rennet how-

ever, being specially prepared by each maker. At the expiration of from 20 to 40 minutes the curd has become firm and manipulation then commences. In the first place it is cut through slowly and regularly with a wooden knife called a *sabre de bois*, which reaches to the bottom of the kettle. It is then left for a short time for the whey to divide from the curd, and afterwards heated afresh to a much higher temperature before it is again cut up. The breaking of the curd continues for some time, until at last, the whey being removed, it gets harder, and forms into small grains. The operator then takes a large cloth, stretches a metal band across one end, and this he dips to the very bottom of the kettle beneath the curd, which is ingeniously gathered into the cloth. The metal band is then disengaged, the four corners of the cloth affixed to a hook suspended over the vat, and the whole is immediately swung across and dropped into the centre of a huge *Gruyère* hoop which is placed upon a table. Here it is worked into shape, cleverly covered with dry cloths, the hoop pulled tightly, and the cheese well bound within it. It is then placed in the cheese press, where it remains for about three hours, a pressure of eighteen pounds being given for each pound of cheese. After this it is taken out and provided with clean cloths and again pressed, the changing of the cloths taking place four, five, and even six times during the day. The next morning the cheese is again taken out and placed upon a table for salting, being first well scraped or pared. The salt is laid upon the surface, and well brushed in with a brush provided for the purpose, about 4 lbs. of salt being used for 100 lbs. of cheese.

It is then taken to the cheese-room and placed upon a shelf, and here it is that it is either perfected or spoiled, for if the temperature is too low it becomes hard and solid, and if too high it swells, and large holes are formed within. If, however, the maker tests each cheese with his finger daily, there is little fear of any being spoiled. Good Emmenthaler or Gruyère, as the same cheese is called in France, where it is also made, is one of the choicest products of the dairy.

Gruyère.—Gruyère in Switzerland is a half-fat cheese, the evening's milk being skimmed and then added to the milk of the morning, the latter being heated to a temperature of 110° F. before the addition of the evening's milk, so that the mean temperature of the mixture is about 93° F. before the rennet is added. The system of adding rennet is controlled by a simple experiment which the maker employs, adding one spoonful to three spoonfuls of milk before the bulk of the milk is touched. If this minute quantity sets in sixty to eighty seconds, all well and good, and he is satisfied of the strength of the rennet. As a general rule, the proportion is 1 part of rennet to 140 parts of milk. When set, the curd is cut, as in the case of the Emmenthaler. The remainder of the system of manufacture very much resembles that described above. A hundred pounds of milk usually make nine to eleven pounds of Emmenthaler cheese, or six to eight pounds of the poorer Gruyère.

Vacherin.—The Vacherin cheese is chiefly made in Canton Fribourg. New milk is heated to a temperature

of 100° to 104° F., and after the curd has set it is gently divided with a net made for the purpose, and left for an hour, when the whey will be found at the top of the vessel. This is then baled out and the curd placed in a mould, in which it is left to drain for fifteen minutes, being wrapped in a cloth and slightly pressed. The cheese is turned, and the cloth changed four times during the day, in order that the whey may be completely pressed out or absorbed. It is taken out of the mould the next day, and laid upon a clean cloth and left to dry and ripen, being turned and the cloth changed every second day.

Schabzieger.—This cheese, which is famous in some parts of Switzerland, is chiefly made from the albuminous portion of the milk called *séré;* and, strange to say, the more completely the milk is skimmed the more successful is the manufacture of the cheese. The milk is heated until boiling point, when a quantity of cold butter-milk is added, little by little. Next a small quantity of *azi*—a prepared sour butter-milk—is added, and the mixture removed from the fire. Coagulation having now taken place, the mass is stirred with a large spoon, and after being allowed to stand for a short time the solid portion is taken out and placed in boxes prepared for the purpose, pressed, and then subjected to a heat of 60° F. in order to start fermentation. This is but the beginning of the manufacture, for it is allowed to ferment for some weeks, when the cheese is ground and salted, and a small quantity of a herb named *Melilotus cærulea,* which is finely pulverised, added, to impart the well-known flavour of the *zieger.* The

cheese is now beaten, and made up into very small conical shapes. It is estimated that thirty pounds of skim-milk will make three and a half pounds of Schabzieger, which is not eaten as is ordinary cheese, but mixed with butter and spread upon bread.

Since the above lines were written we have frequently pointed out that the leading varieties of cheese which we import from the Continent can be made as perfectly in Great Britain as in their respective countries. Dairy farmers do not, however, embrace the opportunity, sound and unmistakable as it is. But foreigners have been over to us to learn to make Cheddar and Stilton, and efforts are already being made to produce Continental Cheddar for the British market; while we British Dairy Farmers on our side, so far from manufacturing Gruyère, Parmesan, and Camembert for export, do not attempt to produce either for our own consumption. We have shown the way by precept and in practice; more we cannot do.

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